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ABSTRACT

A meteorological study was performed by the Air Quality Bureau in the Columbia Falls area of northwestern Montana. The study was conducted: (1) to measure surface and upper air meteorology necessary for air pollution potential determinations; (2) to measure surface and upper air meteorology necessary to define the airflow around Teakettle Mountain adjacent to the Anaconda Company aluminum reduction plant; and (3) to measure and correlate visibility with meteorology of the Columbia Falls area. The study was conducted from October, 1976 through June, 1978.

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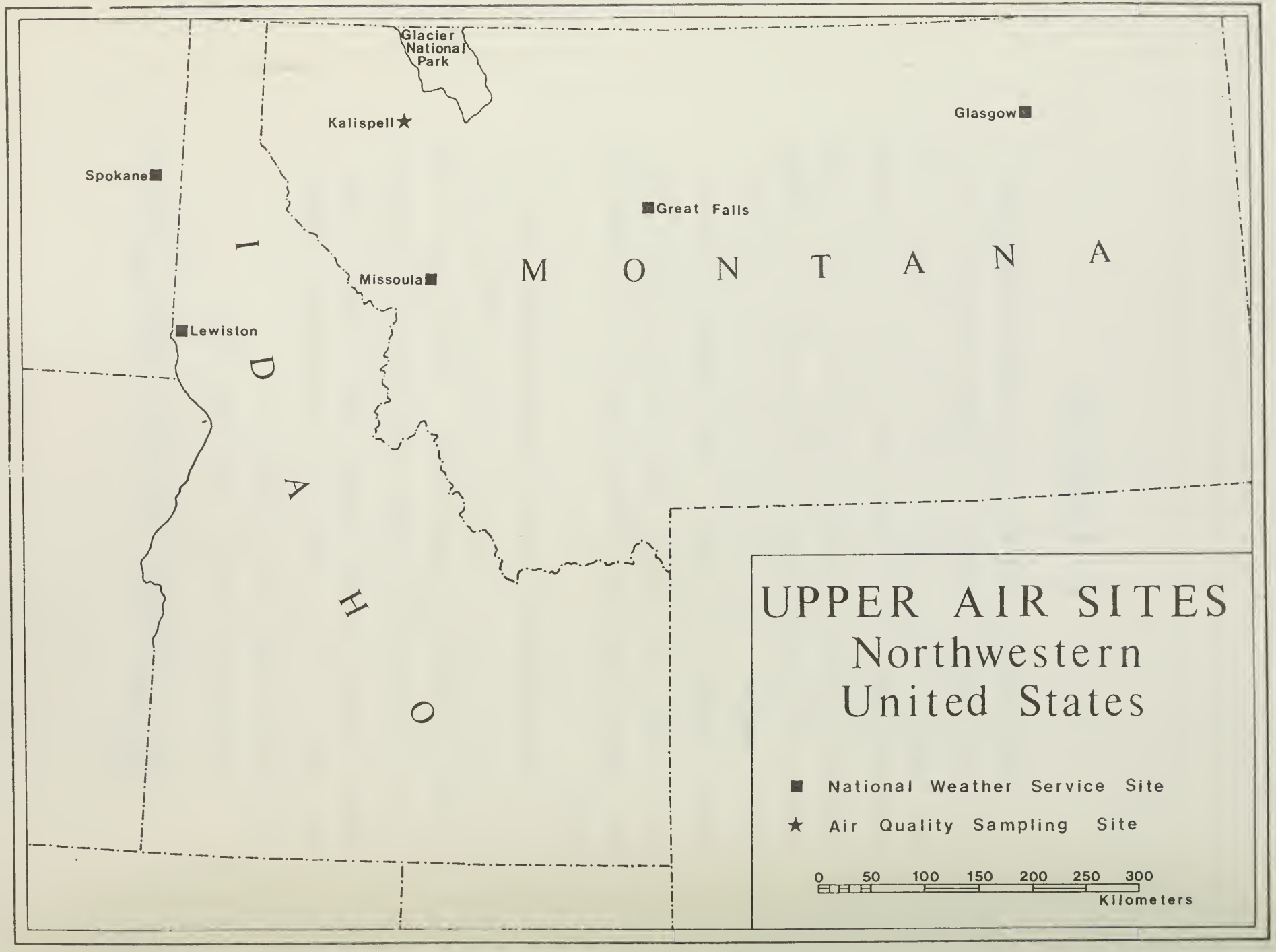
I. INTRODUCTION

The Air Quality Bureau of the Montana Department of Health and Environmental Sciences conducted a meteorological study of the Columbia Falls, Montana, area from September, 1976 through June, 1978. The study was conducted through funds made available by the variance request from the Anaconda Aluminum Company at Columbia Falls, Montana. The study was conducted to obtain a meteorological data base for the northern Flathead Valley area and to obtain data on the airflow around the Teakettle Mountain directly north of the Anaconda plant.

The Columbia Falls area and even broader, the Flathead Valley, has never had any detailed meteorological studies performed on it. Previous work in the area relied on surface data collected by the National Weather Service at the Glacier International Airport and upper air data collected at Great Falls, Montana or Spokane, Washington (Figure 1).

The objectives of the study were then:

(1) To measure surface and upper air meteorological parameters necessary to prepare a data base sufficient for air pollution potential determinations;


Glacier National Park
Kalispell
Glasgow
Spokane
Great Falls
M O N T A N A
Missoula
Lewiston
I D A H O
UPPER AIR SITES
Northwestern United States
National Weather Service Site
Air Quality Sampling Site
0 50 100 150 200 250 300
Kilometers

(2) To measure surface and upper air meteorological parameters necessary to define the airflow around Teakettle Mountain; and
(3) To measure and correlate visibility readings with meteorology of the Columbia Falls area.

Chapter II summarizes the air pollution potential determination of the data base collected. Chapter III summarizes data collected to determine the Teakettle Mountain airflow. Chapter IV summarizes the visibility portion of the study. Summary and recommendations are presented in Chapter V. Appendix A contains the more lengthly data summaries, whereas some summary tables are presented in the text. Appendix B describes the data collection techniques and instrumentation used in the study.

II. GENERAL AIR POLLUTION POTENTIAL

General Climatology

Montana's air pollution problems are enhanced by the topography in the western one-third of the state. High mountains with narrow valleys running north to south cause poor dispersion problems for many areas. Pollutants become trapped in the valleys due to frequent inversions and can remain trapped for extended periods of time. Although the area is not over-run with industrial activity, one or two large pollution sources can affect a large area and cause ambient air standards to be exceeded. The Flathead Valley is a fairly wide valley with mountains bordering on all sides. The valley floor is fairly flat, sloping toward the south. The mountains on the east rise to 7000 feet (3000 feet above the valley floor). Flathead Lake, the largest of Montana's lakes, borders the valley on the south. To the west the mountains rise to 5000 feet above sea level or 2000 feet above the valley floor. To the north the mountains rise to 6000 feet mean sea level (msl). The valley is some 12 miles wide at the north end narrowing to only 7 miles wide at the south end. Several smaller valleys drain into the Flathead Valley

on the northeast, northwest, southwest and southeast. These smaller valleys have a major influence on the general circulation in the valley. The Flathead Lake also influences the micro-climatology of that area. Often the lake never freezes due to its size and fairly mild climate surroundings. This lake can cause a small-scale sea breeze to be noted. This phenomena is investigated further later in this report.

The climate of the Flathead Valley differs materially from that just east of the continental divide (the divide is approximately 40 miles to the east of the valley); it can principally be attributed to the influence of the topographical features. The high mountains to the east form an effective barrier to many severe winter cold waves that move down over sections east of the Rockies from Alberta. The elevation of the mountains to the east rise abruptly 4,500 feet above the valley floor. The snow remaining on the crests until late spring assure frequent and beneficial rains by cooling of moist air moving from the west.

In addition to Flathead Lake, the valley contains four smaller lakes, three rivers, and numerous streams and sloughs. Until late in the winter when a large portion of the lakes and sloughs become frozen over, this water surface tends to limit temperature extremes. This effect is most noticeable in the southern end of the valley because of Flathead Lake influence.

The weather at Columbia Falls is considerably different in some respects from the weather in Kalispell. Generally there is more cloudiness in Columbia Falls since it is closer to the mountains to the east and north. Moist air moving in from the west and southwest, lifting and cooling as it moves over the mountains, is the major cause. In connection with this, there averages more precipitation on the east side of the valley than on the west side. Average snowfall during the winter at the Glacier International Airport is 68 inches and in Kalispell it is 49 inches.

Starting in March and lasting through September, the prevailing wind from 1100 MST until 1900 MST is from the southeast. This wind blows off Flathead Lake and is caused by the land surfaces heating more in the daytime than the water surface of the lake. This wind is very noticeable both at Kalispell and the airport, often reaching 20 mph and occasionally quite gusty. There are, of course, times when the wind during this period is not from the southeast. Other effects such as cloudiness, frontal passages, etc., may cause the wind to be from another direction. The year-round prevailing wind direction at Kalispell is from the west, and at the airport it is from the south. Wind speeds average considerably stronger at the airport than in Kalispell.

In the winter, when a cold wave moving down the east side of the continental divide does come through the

mountains, the airport is in direct line with the pass the cold air comes through. During these cold waves the wind is from the northeast and will usually have speeds reaching 30 to 40 mph. The strongest gust reported during one such storm was 84 mph. As the cold air moves down the valley it spreads out, decreasing the wind velocity, and mixes with the warmer air of the valley. Unless these cold strong winds persist for 3 or 4 days, the wind in the lower part of the valley will be from the northwest, because of the influence of Flathead Lake and the mountains to the west. This wind is always much stronger in the northeast end of the valley where the airport is located than any other place in the valley. In the northwest corner where Whitefish is located and in the southeast part of the valley, there is rarely much wind from this storm (NOAA, 1977).

Surface Meteorology

Stability

Stability data is very important to air pollution potential determinations. The term stability relates in air pollution to the horizontal and vertical ability of the atmosphere to disperse air pollutants. A stable classification is similar to stagnant conditions caused by low wind speeds and inversion conditions. An unstable classification is related to rapid air movements and

enhanced or bouyant vertical air movements. A high frequency of stable conditions can cause air pollutants to become trapped and build up until increased wind speeds or sunshine can heat up the air causing vertical air movements.

Stability data was collected under the Columbia Falls study using the acoustic radar (see Appendix B). Meteorologists reduced the radar charts to computer format assigning a two hour relative stability (stable, neutral, or unstable) for the lowest 100 meters of the radar chart. The relative stabilities were then refined by computer analysis to six stabilities using a modified version of the stability scheme proposed by Turner (1970). The method of stability classification used in the radar analysis is summarized in Table 1. Tabulations of the monthly stabilities are given in Appendix A. Table 2 summarizes the monthly frequency of stability occurrences.

Under the Turner stability classification scheme stable cases could not occur during daylight hours. However, under this modified scheme the Columbia Falls data does show E and F stabilities occurring at all hours of the day. Certain days an inversion persisted at the surface all day causing a stable classification to be assigned throughout the day. On the other hand, very unstable classifications (A) occurred very seldom

TABLE 1

STABILITY CLASSIFICATION FROM ACOUSTIC RADAR CHARTS

Initial Classification	Event Occurring*	Wind Speed	Night-Time	Cloud Cond.	Solar Radiation	Final Classification
Stable	Yes	-	-	-	-	Neutral
	No	$<$3m/sec	Yes	$\leq$3/8	-	Moderately stable
	No	$<$3m/sec	Yes	OVC or $\geq$4/8	-	Slightly stable
	No	$<$5m/sec	Yes	$\leq$3/8	-	Slightly stable
	No	$<$5m/sec	Yes	OVC or $\geq$4/8	-	Neutral
	No	$\geq$5m/sec	Yes	-	-	Neutral
Unstable	Yes	-	-	-	-	Neutral
	No	$<$ 2				
Neutral	-	-	-	-	-	Neutral

*Event includes precipitation, inversion breakup, or frontal passage.

TABLE 2

FREQUENCY OF OCCURRENCE OF TWO HOUR STABILITIES

	A	B	C	D	E	F	M+
Oct., 1976	0.0	0.8	13.2	14.5	19.1	16.9	35.5
Nov.	0.0	3.9	5.8	24.4	42.2	13.1	10.6
Dec.	ND*	ND	ND	ND	ND	ND	ND
Jan., 1977	0.0	3.5	3.8	34.9	25.0	5.1	27.7
Feb.	0.0	2.1	3.3	19.0	38.4	14.0	23.2
March	0.0	0.5	9.4	16.1	13.4	4.0	56.5
April	0.0	2.8	23.9	16.1	20.8	15.6	20.8
May	0.0	1.1	25.0	29.0	31.7	7.8	5.4
June	0.3	1.7	28.9	21.9	18.3	16.9	11.9
July	0.0	1.1	28.5	28.2	19.1	12.9	10.2
Aug.	0.0	4.6	21.2	19.4	24.7	8.6	21.5
Sept.	0.0	1.4	13.1	20.3	10.6	13.3	41.4
Oct.	0.0	3.2	16.7	19.4	31.5	26.1	3.2
Nov.	0.0	1.1	5.3	26.1	43.9	8.6	15.0
Dec.	0.0	1.1	1.1	34.4	44.1	4.8	14.5
Jan., 1978	0.0	0.0	1.9	34.1	48.1	4.6	11.3
Feb.	0.0	1.2	6.8	28.9	57.4	5.7	0.0
March	0.0	4.0	14.5	22.8	45.4	13.2	0.0
Apr.	0.0	0.6	16.7	19.4	21.4	9.2	31.7
May	0.5	1.1	7.8	29.8	16.9	5.4	37.4

*ND = no data

+M = Missing

and only during the summer months and daylight hours. Frequencies of occurrence by months show the months of April through August as the most unstable months with the highest unstable frequency occurring in June, 1977 (30.9 percent). The most stable months were October through March with the highest stable frequency occurring in February, 1978 (63.1 percent). The least unstable month (month with the lowest unstable frequencies) was January, 1978 (1.9 percent). The least stable month was July, 1977 (31 percent). Stable conditions occurred very frequently during all months, possibly due to the high frequency of occurrence of inversion conditions (during July, 1977 inversions were present 25 percent of the time even though it was the least stable month).

The stability data demonstrates that the greatest air pollution problems are likely to occur during October through March when frequent stable conditions occur. During this period the longest duration of stable conditions occurred for 3½ days during November. Longer periods of stable conditions occurred during other months but contained brief periods of neutral stabilities. Even though the months of April through September contained fewer stable cases, all months potentially could experience brief stagnation conditions of a half day or more.

Surface Wind

Surface wind speed and direction were measured at three locations in the valley. These included the Glacier International Airport site, the Badrock Canyon site, and the Teakettle Mountain site. The airport site was picked to describe the general wind pattern of the northern Flathead Valley. The Badrock Canyon site was selected to monitor the wind flow in and out of the Badrock Canyon. Finally the Teakettle Mountain site was designed to monitor the surface wind flow north of the aluminum plant near Teakettle Mountain.

Surface wind conditions are very important to an air pollution potential determination. The wind direction determines where pollutants will be carried while the speed determines how fast the pollutants will be dispersed. A high occurrence of very slow or calm wind speeds will allow the air pollutants to accumulate near a pollution source. Also a high occurrence of wind directions from one direction will cause certain areas to be subject to increased air pollution throughout the year while other areas escape the effects.

Glacier International Airport

The diurnal wind pattern at the Glacier International Airport follows that reported by NOAA (1977) very closely. About 1100 MST from March through September the wind direction shifts from a predominantly

northerly wind to a southerly (Tables 3 and 4). At the same time, the speed increases from about 2 meters per second (5 miles per hour) to about 5 meters per second (m/sec). This southerly wind continues until 1900 MST or later, depending on the amount of sunlight available. During the summer months the wind shift also can occur earlier than 1100 MST. This pattern continues most of the year until snow cover reduces the lake breeze effect.

The lake effect or sea breeze as termed near oceans is caused by the land surface being heated faster than the water during a sunny day. As the land warms the air above this land is warmed and starts to rise. As the air rises it is replaced by air over the lake. The rising air then moves over the lake higher up. This cycle sets up a wind movement from the lake to the land and in the case of the Kalispell area causes a southerly wind.

Over the long term average, the data collected at the Glacier International Airport shows the highest frequency of winds from the south during all months (Table 5). The 45 degree quadrant from south-southeast to south-southwest accounts for anywhere from 22 percent of the winds during November to 34 percent of the winds in May. These southerly winds average from 4 to 5 m/sec. year round. Since Flathead Lake rarely freezes over,

TABLE 3

SURFACE WIND DIRECTION FREQUENCY (PERCENT)
GLACIER INTERNATIONAL AIRPORT (NWS)
Jan. 1977-June 1978

Direction	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	Sp	Su	Fa	Wi	Yr
N	6.5	3.9	8.3	8.8	8.5	9.8	5.2	11.3	8.2	5.6	0.4	6.1	7.7	9.4	7.3	10.8	6.0	6.2	8.2	8.1	4.7	6.9	7.2
NNE	5.6	1.7	0.7	5.9	8.5	5.1	7.8	17.7	5.8	4.4	6.3	8.3	10.5	8.5	6.8	15.0	4.8	3.3	7.4	8.7	5.5	7.2	7.3
NE	1.9	0.0	1.4	6.5	7.1	7.5	4.4	13.7	5.3	1.7	4.0	4.4	6.4	13.4	9.3	11.2	8.5	6.2	7.9	8.0	3.6	5.5	6.5
ENE	1.9	1.1	1.4	3.5	1.4	0.0	1.7	2.4	0.5	0.9	0.4	0.9	1.2	0.4	0.0	1.2	1.2	2.1	1.3	1.6	0.6	1.1	1.2
E	0.5	1.1	0.0	2.4	4.2	1.4	2.2	2.8	1.0	2.6	0.9	0.4	0.4	0.4	0.0	1.2	0.8	2.9	1.4	2.4	1.5	0.5	1.4
ESE	0.5	0.6	2.1	2.4	0.9	1.9	0.9	2.0	0.5	0.0	0.0	0.0	0.0	0.4	0.4	0.4	1.2	1.7	1.1	1.6	0.2	0.3	0.8
SE	0.5	1.7	5.6	2.9	2.8	1.9	2.6	3.6	1.0	0.9	2.7	0.0	0.0	1.3	0.8	2.1	2.0	2.5	2.4	2.7	1.5	0.6	1.8
SSE	0.9	10.7	11.8	5.8	7.6	5.1	8.3	5.6	6.8	5.2	3.2	3.9	1.2	4.0	4.4	12.5	8.1	9.2	8.2	7.1	5.0	3.8	6.2
S	4.2	14.6	23.6	13.5	19.8	16.4	21.7	10.1	18.0	16.1	20.3	16.1	6.0	7.6	12.1	12.1	18.6	20.4	16.2	17.1	18.1	9.5	14.9
SSW	3.3	5.6	6.2	2.4	6.1	3.7	1.7	2.8	6.3	3.5	9.0	2.2	2.8	1.3	3.6	3.3	4.8	3.3	4.3	2.9	6.2	2.9	3.9
SW	2.3	2.2	4.2	2.4	3.3	6.1	4.4	2.4	2.4	3.9	8.1	2.6	3.2	1.3	4.8	5.0	9.7	2.1	5.2	3.7	4.8	2.4	4.0
WSW	2.3	3.4	5.6	5.8	5.7	6.5	7.8	2.4	2.4	3.5	5.0	4.8	3.2	4.0	7.3	2.5	6.0	5.8	5.5	5.6	3.7	3.6	4.7
W	4.7	4.5	2.8	4.8	3.3	6.1	5.2	3.2	3.9	3.0	2.7	2.6	1.2	1.3	3.2	5.4	2.8	5.4	3.7	4.9	3.2	2.7	3.6
WNW	2.8	4.5	2.8	1.8	1.4	2.8	3.9	2.0	1.9	1.7	2.7	0.9	0.8	1.3	0.0	1.7	2.4	0.8	1.6	2.3	2.1	1.9	1.9
NW	2.8	1.7	4.2	2.9	1.9	4.2	4.4	2.4	2.9	0.4	1.4	2.2	2.8	0.4	1.2	2.5	2.4	3.3	2.4	3.5	1.5	2.0	2.4
NNW	4.7	2.8	4.2	3.5	3.3	6.5	3.0	0.0	2.4	2.2	3.6	3.5	2.4	1.8	1.2	2.5	4.4	3.8	3.1	3.2	2.7	3.0	3.0
% Calm	54.7	39.9	15.3	24.7	14.2	15.0	14.8	15.3	30.6	44.3	29.3	41.3	50.0	42.9	37.5	10.4	16.1	20.8	20.0	16.5	35.0	45.2	28.7
Hours*	214	178	144	170	212	214	230	248	206	230	222	230	248	224	248	240	248	240					

*NWS data are 3-hour observations

TABLE 4

SURFACE WIND SPEED (m/sec)
GLACIER INTERNATIONAL AIRPORT (NWS)
Jan. 1977-June 1978

Direction	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	Sp	Su	Fa	Wi	Yr
N	1.6	0.1	1.7	2.2	2.5	2.2	2.0	2.1	1.3	1.2	0.0	1.3	1.5	1.3	1.1	2.3	1.9	1.6	2.0	2.0	1.2	1.2	1.6
NNE	5.7	2.7	2.5	3.7	4.6	4.0	2.7	5.6	3.4	2.5	5.5	6.4	6.8	5.6	5.7	4.9	3.5	4.4	4.2	4.2	3.8	5.4	4.4
NE	4.3	0.0	10.0	3.9	4.3	4.4	4.4	4.9	4.7	2.5	4.4	6.1	5.6	6.4	6.3	5.5	4.8	3.9	5.8	4.4	3.9	5.6	4.9
ENE	1.8	1.5	2.5	3.8	2.3	0.0	3.8	3.3	2.0	1.8	2.0	2.0	2.7	6.0	0.0	1.8	5.3	3.3	3.1	3.5	1.9	2.8	2.8
E	2.0	1.5	0.0	2.6	3.7	2.5	3.3	2.6	3.0	1.9	2.0	2.0	3.0	2.5	0.0	2.2	2.3	2.2	2.7	2.6	2.3	2.2	2.4
ESE	2.5	1.5	1.7	2.5	1.8	1.8	2.3	2.4	2.0	0.0	0.0	0.0	0.0	2.0	1.5	2.0	3.0	2.6	2.1	2.3	2.0	2.0	2.1
SE	1.5	3.5	3.8	3.1	4.3	4.8	3.3	3.1	2.3	2.0	3.0	0.0	0.0	2.7	3.0	3.6	3.9	3.6	3.6	3.7	2.4	2.6	3.1
SSE	3.3	4.8	4.4	4.3	4.6	5.4	3.8	3.9	3.5	3.2	3.1	5.4	4.3	4.4	4.5	4.1	4.7	4.2	4.4	4.3	3.3	4.4	4.1
S	2.1	3.9	4.4	3.5	4.4	4.1	3.9	3.8	4.1	3.6	3.8	4.3	4.2	3.7	4.4	4.0	4.0	4.4	4.1	4.0	3.8	3.9	4.0
SSW	2.1	2.6	4.1	2.9	3.1	3.6	3.5	4.4	3.0	3.5	4.3	4.3	2.8	2.7	3.3	4.9	3.9	3.0	3.7	3.6	3.6	2.9	3.4
SW	2.0	2.6	4.3	4.1	4.0	5.2	4.8	3.3	4.5	4.2	4.0	2.8	4.7	2.0	3.0	4.8	4.1	2.1	4.0	3.8	3.0	2.1	3.0
WSW	2.2	3.5	3.7	4.7	4.3	4.4	4.5	4.2	4.0	2.4	3.9	3.6	2.3	2.6	3.1	4.8	4.3	3.8	4.2	4.2	3.4	2.8	3.6
W	2.1	2.8	2.6	2.3	3.7	4.4	3.7	2.6	2.6	2.6	3.8	1.8	2.0	1.7	3.2	4.4	3.4	4.3	3.3	3.8	3.0	2.1	3.0
WNW	1.8	1.9	1.8	3.0	2.3	3.6	2.8	4.2	3.5	2.4	2.0	2.3	2.0	2.0	0.0	2.3	2.9	6.3	2.5	4.2	2.6	2.0	2.8
NW	2.3	2.2	3.0	2.2	2.9	2.8	2.2	2.0	3.2	4.5	2.8	2.1	3.0	2.5	2.8	3.6	3.0	3.3	3.0	2.6	3.5	2.4	2.9
NNW	3.4	2.1	2.0	3.3	3.0	2.6	3.1	0.0	2.6	3.3	3.1	3.3	2.3	2.8	2.3	3.3	3.7	2.4	2.9	2.7	3.0	2.8	2.8
Ave. Speed All Hours	1.2	1.9	3.1	2.5	3.3	3.2	3.0	3.4	2.3	1.6	2.7	2.4	2.0	2.3	2.5	3.7	3.3	2.9	3.1	3.1	2.2	2.0	2.6
Hours*	214	178	144	170	212	214	230	248	206	230	222	230	248	224	248	240	248	240					

*NWS data are 3-hour observations

TABLE 5

WIND: Percentage Frequency by Directions, in Selected Speed Increments by Months

Kalispell Airport — MONTANA

JANUARY

HOURLY OBSERVATIONS OF WIND SPEED MILES PER HOUR

DIR	1 TO 3	4 TO 7	8 TO 12	13 TO 18	19 TO 24	25 TO 31	32 TO 38	39 TO 46	OVER 46	TOTAL	AVE SPEED
N	1.4	1.7	0.9	0.8	0.3	0.3	*	0.1		5.2	9.2
NNE	0.8	0.8	0.9	1.1	1.4	1.5	1.1	0.9	0.4	9.0	22.4
NE	1.3	1.2	0.7	0.8	0.4	0.3	0.1	0.1	*	4.9	11.1
ENE	0.2	0.2	0.1							0.5	4.6
E	0.5	0.2	0.1							0.8	3.8
ESE	0.2	0.1								0.3	3.2
SE	0.5	0.3	0.2	0.2						1.3	6.6
SSE	0.4	1.0	4.4	3.4	1.0	0.1				10.2	12.4
S	1.4	3.1	5.7	2.7	0.4	0.1				13.3	9.5
SSW	1.1	1.8	2.3	0.8	0.1	*				6.0	8.0
SW	1.6	2.4	1.2	0.8	0.3	*				6.4	7.6
WSW	0.7	0.7	0.2		0.1					1.8	5.5
W	1.5	1.0	0.1	0.1	*					2.7	4.2
WNW	0.6	0.6	0.1							1.2	4.2
NW	1.5	1.6	0.4	0.1						3.5	4.7
NNW	1.0	1.4	0.9	0.4	0.1					3.8	7.3
CALM	29.0									29.0	
TOTAL	43.6	18.2	19.0	11.0	4.2	2.3	1.3	1.1	0.4	100.0	7.4

FEBRUARY

HOURLY OBSERVATIONS OF WIND SPEED MILES PER HOUR

DIR	1 TO 3	4 TO 7	8 TO 12	13 TO 18	19 TO 24	25 TO 31	32 TO 38	39 TO 46	OVER 46	TOTAL	AVE SPEED
N	1.8	1.6	0.8	0.7	0.5	*	0.1	*	*	5.9	8.4
NNE	0.9	1.1	0.6	1.8	1.3	0.8	0.2	*		6.7	15.1
NE	1.6	1.4	0.6	0.6	0.2	0.1	*			4.6	8.0
ENE	0.3	0.2	*							0.5	4.2
E	0.4	0.3	*							0.8	3.7
ESE	0.3	0.1	0.1							0.5	4.6
SE	0.5	0.4	0.7	0.6	0.1	*				2.2	6.5
SSE	0.6	2.0	4.0	3.4	0.6	4				10.7	11.1
S	1.4	4.4	5.1	1.6	0.6	0.1				13.2	8.8
SSW	1.4	2.4	2.2	1.3	0.2	4				7.4	8.1
SW	1.5	2.2	1.2	1.1	0.5	0.1				6.7	8.8
WSW	0.4	0.6	0.2	0.5	0.1	4				1.8	9.0
W	0.9	0.5	0.4	0.2	*					2.0	6.1
WNW	0.7	0.6	0.1	*						1.5	4.5
NW	2.0	1.4	0.8	0.1	*					4.2	5.0
NNW	1.0	1.3	0.7	0.4	*					3.4	6.5
CALM	27.8									27.8	
TOTAL	43.5	20.8	17.5	12.3	4.1	1.3	0.4	0.1	*	100.0	6.5

MARCH

HOURLY OBSERVATIONS OF WIND SPEED MILES PER HOUR

DIR	1 TO 3	4 TO 7	8 TO 12	13 TO 18	19 TO 24	25 TO 31	32 TO 38	39 TO 46	OVER 46	TOTAL	AVE SPEED
N	2.5	1.7	1.0	0.4	0.1					5.8	5.9
NNE	0.7	1.1	1.2	1.5	1.5	1.4	0.6	0.3		8.5	17.6
NE	1.2	1.6	1.4	1.4	1.1	0.6	0.1	*		7.5	12.2
ENE	0.2	0.4	0.3	0.3	0.1					1.1	8.3
E	0.5	0.4	0.1							1.0	4.4
ESE	0.3	0.3	*							0.7	4.2
SE	0.7	1.0	0.8	0.5	0.1	*				3.0	8.0
SSE	0.9	2.4	4.7	4.0	0.7	0.1				12.8	10.9
S	1.5	4.1	5.6	1.7	0.3	*				13.2	8.5
SSW	1.2	2.6	2.3	1.4	0.2	*	*			7.8	8.8
SW	1.6	1.7	1.5	1.7	0.7	0.1	*	*		7.3	9.8
WSW	0.6	0.5	0.2	0.9	0.1	*				2.3	9.8
W	1.0	0.4	0.3	0.2	0.1					2.0	6.5
WNW	0.5	0.9	0.3	0.1	0.1					1.7	5.8
NW	1.6	1.2	0.5	0.2	*	*				3.5	5.5
NNW	1.1	1.1	0.6	0.2	*		*			3.0	6.1
CALM	18.8									18.8	
TOTAL	35.0	21.5	20.7	14.3	5.0	2.3	0.8	0.4		100.0	7.9

APRIL

HOURLY OBSERVATIONS OF WIND SPEED MILES PER HOUR

DIR	1 TO 3	4 TO 7	8 TO 12	13 TO 18	19 TO 24	25 TO 31	32 TO 38	39 TO 46	OVER 46	TOTAL	AVE SPEED
N	1.7	2.2	1.8	1.0	0.1					7.0	7.6
NNE	0.5	1.5	2.2	2.9	1.6	0.5	0.1	0.2		9.6	14.0
NE	1.7	2.7	2.3	1.7	0.9	0.4	*			9.8	10.0
ENE	0.5	0.7	0.3	0.3						1.9	6.8
E	0.6	0.8	0.2	0.1						1.7	5.2
ESE	0.4	0.3	0.1	*						0.8	4.8
SE	1.0	1.2	1.0	0.8	0.1	*				4.1	7.6
SSE	1.0	2.6	4.1	3.0	0.3					11.1	10.0
S	1.0	3.0	4.9	2.5	0.1					12.4	8.6
SSW	0.8	1.7	2.0	1.2	0.3	*				6.1	9.4
SW	1.3	1.4	1.5	2.3	1.0	0.1				7.5	11.3
WSW	0.3	0.4	0.5	1.0	0.3	*				2.6	11.9
W	0.7	0.6	0.5	0.6	0.2	*				2.6	9.2
WNW	0.7	0.7	0.4	0.2	0.1					2.1	7.2
NW	1.7	1.9	0.7	0.3	*					4.7	5.9
NNW	1.0	1.7	0.9	0.1	*	*				3.7	6.3
CALM	12.2									12.2	
TOTAL	27.2	24.6	23.3	18.1	5.4	1.2	0.1	0.2		100.0	8.4

MAY

HOURLY OBSERVATIONS OF WIND SPEED MILES PER HOUR

DIR	1 TO 3	4 TO 7	8 TO 12	13 TO 18	19 TO 24	25 TO 31	32 TO 38	39 TO 46	OVER 46	TOTAL	AVE SPEED
N	1.4	1.5	1.7	0.7	0.1	*				6.2	7.4
NNE	0.9	1.6	2.7	2.4	0.8	*				8.5	10.6
NE	1.3	2.4	3.2	2.0	0.5	0.1	*			9.5	8.5
ENE	0.5	0.9	0.5	0.2	*					2.2	6.8
E	0.8	1.0	0.4	0.1						2.3	5.6
ESE	0.5	0.6	0.2	0.1	*					1.4	6.1
SE	1.1	1.6	1.1	0.7	0.1					4.7	7.4
SSE	1.2	3.1	5.0	4.4	0.9	*				11.5	10.4
S	1.2	4.5	5.7	2.5	0.3	*				14.2	9.0
SSW	0.8	2.2	1.9	0.8	0.1	*				6.1	8.1
SW	1.1	1.5	2.0	1.0	0.6	0.1				5.8	10.0
WSW	0.2	0.5	0.8	0.9	0.6	0.1	*			3.1	13.1
W	0.4	0.9	0.6	0.4	0.2	*				2.6	8.0
WNW	0.4	0.9	0.3	0.2	*	*				1.9	7.3
NW	1.1	1.9	1.0	0.9	0.2					4.5	6.1
NNW	0.9	1.7	1.1	0.2	*	*				3.9	9.6
CALM	9.5									9.5	
TOTAL	23.4	27.1	27.0	16.6	4.6	0.5	*			100.0	8.1

JUNE

HOURLY OBSERVATIONS OF WIND SPEED MILES PER HOUR

DIR	1 TO 3	4 TO 7	8 TO 12	13 TO 18	19 TO 24	25 TO 31	32 TO 38	39 TO 46	OVER 46	TOTAL	AVE SPEED
N	1.2	2.3	2.0	0.5	0.1					6.0	7.2
NNE	0.6	1.9	2.1	1.7	0.5	0.1	*			6.9	10.5
NE	1.4	2.3	2.3	2.1	0.7	0.1	*			9.0	9.8
ENE	0.3	1.2	0.4	0.2	*					2.1	6.7
E	0.7	1.2	0.2	*						2.2	4.8
ESE	0.4	0.5	0.2							1.1	5.7
SE	1.1	2.1	1.3	0.8	*					5.4	7.3
SSE	1.2	3.2	4.0	3.2	0.9	0.1				12.5	10.0
S	1.6	5.3	7.0	1.8	0.1	*				14.6	8.2
SSW	1.0	2.2	1.6	1.1	0.1					5.9	7.9
SW	1.1	1.9	1.3	2.2	0.4					6.8	8.6
WSW	0.6	0.5	0.5	0.9	0.3					2.8	11.1
W	0.6	1.1	0.5	0.3						2.5	6.1
WNW	0.1	1.0	0.5	0.2						1.7	6.7
NW	0.9	2.0	0.9	0.2		*				4.1	6.3
NNW	0.4	1.6	1.1	0.2	*	*				3.8	6.8
CALM	12.6									12.6	
TOTAL	25.8	30.5	25.6	15.4	2.5	0.3	0.1			100.0	7.4

JULY

HOURLY OBSERVATIONS OF WIND SPEED MILES PER HOUR

DIR	1 TO 3	4 TO 7	8 TO 12	13 TO 18	19 TO 24	25 TO 31	32 TO 38	39 TO 46	OVER 46	TOTAL	AVE SPEED
N	1.2	2.6	1.2	0.6	*					5.7	6.6
NNE	0.7	2.6	1.6	1.9	0.4	0.1				8.6	9.4
NE	1.7	3.2	2.4	1.3	0.1					8.6	7.7
ENE	0.4	0.9	0.4	0.1						1.7	5.6
E	1.1	1.3	0.1	0.1						2.8	4.4
ESE	0.7	1.0	0.2							1.8	4.6
SE	1.4	2.9	1.4	0.5	0.1					6.8	6.5
SSE	1.2	3.9	4.5	1.8	0.3					11.7	8.8
S	1.6	5.6	4.9	1.4	*					13.6	7.7
SSW	1.0	2.5	1.8	0.4	*					5.7	7.1
SW	1.0	2.0	1.3	1.5	0.2					6.0	8.8
WSW	0.3	0.5	0.8	0.8	0.1					2.7	11.1
W	0.6	1.2	0.6	0.8	0.1					3.3	8.3
WNW	0.6	.7	0.5	0.2	*					1.1	6.9
NW	1.0	1.7	0.6	0.2	0.1	*				3.5	6.2
NNW	0.5	1.7	0.9	0.1	*					3.2	6.5
CALM	14.2									14.2	
TOTAL	29.1	34.2	23.1	11.0	1.7	0.2				100.0	6.5

AUGUST

HOURLY OBSERVATIONS OF WIND SPEED MILES PER HOUR

DIR	1 TO 3	4 TO 7	8 TO 12	13 TO 18	19 TO 24	25 TO 31	32 TO 38	39 TO 46	OVER 46	TOTAL	AVE SPEED
N	1.3	1.5	2.0	0.4	0.1					6.9	6.9
NNE	0.7	2.2	1.9	2.3	0.6	*				7.8	10.5
NE	1.3	3.1	2.4	1.2	0.1	0.1				8.1	8.3
ENE	0.4	1.0	0.3	0.1	*					1.9	5.9
E	1.0	1.0	0.1							2.1	4.2
ESE	0.6	0.8	0.1							1.5	4.6
SE	1.3	2.1	1.0	0.2	0.1					4.7	6.1
SSE	1.5	1.6	4.5	2.1	*					11.7	8.5
S	1.3	4.3	4.5	1.4	*					11.6	7.9
SSW	0.8	2.5	1.5	0.5	0.1					5.4	7.4
SW	1.1	1.9	1.5	1.3	0.3	*				6.1	8.9
WSW	0.4	0.8	0.5	0.7	0.2					2.6	9.4
W	0.7	0.9	0.5	0.3	*					2.5	6.5
WNW	0.8	1.0	0.4	0.3	*					2.6	6.5
NW	1.1	1.8	0.6	0.2	0.1					3.8	6.4
NNW	1.0	2.4	1.1	0.3						4.8	6.3
CALM	15.8									15.8	
TOTAL	31.2	32.6	22.9	11.2	1.8	0.2				100.0	6.5

SEPTEMBER

HOURLY OBSERVATIONS OF WIND SPEED MILES PER HOUR

DIR	1 TO 3	4 TO 7	8 TO 12	13 TO 18	19 TO 24	25 TO 31	32 TO 38	39 TO 46	OVER 46	TOTAL	AVE SPEED
N	1.7	3.8	1.9	0.6	0.3					8.3	7.0
NNE	1.0	2.1	2.3	1.6	0.9	0.2				8.5	10.7
NE	1.6	2.6	3.0	2.5	0.5	0.1				10.2	9.6
ENE	0.5	0.7	0.5	0.3	*					2.0	7.2
E	0.4	0.4	0.2	0.1	*					1.1	5.1
ESE	0.5	0.6	0.2	*						1.3	4.6
SE	1.1	1.8	0.7	0.2						3.8	5.9
SSE	0.8	3.4	3.5	1.3	0.1					8.9	8.4
S	1.0	4.5	4.7	1.7	0.1					11.8	8.2
SSW	0.7	2.2	1.9	0.7	*					5.6	7.8
SW	1.2	2.0	1.0	1.4	0.6	0.1	*			6.1	9.7
WSW	0.6	0.5	0.3	1.0	0.1	*				2.3	10.7
W	0.8	0.7	0.2	0.4	0.1	*				2.2	7.5
WNW	0.5	0.5	0.2	0.2	*	*				1.5	6.6
NW	1.1	1.8	0.7	0.2	0.1					3.9	5.9
NNW	1.1	1.6	0.7	0.1		*	*			3.6	6.0
CALM	17.6									17.6	
TOTAL	32.6	29.6	21.6	12.5	2.8	0.5	0.1			100.0	6.7

OCTOBER

HOURLY OBSERVATIONS OF WIND SPEED MILES PER HOUR

DIR	1 TO 3	4 TO 7	8 TO 12	13 TO 18	19 TO 24	25 TO 31	32 TO 38	39 TO 46	OVER 46	TOTAL	AVE SPEED
N	1.9	2.6	1.5	0.6	0.2					6.8	6.7
NNE	1.2	1.6	1.3	1.5	1.0	0.4				6.5	11.6
NE	1.6	1.6	1.1	1.3	0.7	0.3	*			5.9	8.6
ENE	0.5	0.6	0.1	0.1						1.3	6.9
E	0.8	0.6	0.1							1.6	5.9
ESE	0.5	0.3	*							0.8	3.7
SE	1.1	0.8	0.4	0.3	0.1					2.6	6.4
SSE	1.2	2.3	3.0	1.7	0.3					8.6	8.9
S	2.4	4.8	5.1	1.4	0.2					13.8	7.6
SSW	1.2	2.3	1.8	1.1	0.3	0.1				6.7	8.4
SW	1.8	2.1	1.2	1.5	0.3	0.1				7.0	8.2
WSW	0.5	0.4	0.5	0.6	0.2	*				2.2	10.1
W	0.9	0.6	0.4	0.2	*					2.1	5.4
WNW	0.8	0.8	0.2	0.1	0.1					1.9	5.6
NW	1.6	1.2	0.4	*						3.3	4.6
NNW	1.0	1.2	0.5	0.1						2.8	5.4
CALM	26.2									26.2	
TOTAL	45.0	23.7	17.5	10.4	2.6	0.7	*			100.0	5.8

NOVEMBER

HOURLY OBSERVATIONS OF WIND SPEED MILES PER HOUR

DIR	1 TO 3	4 TO 7	8 TO 12	13 TO 18	19 TO 24	25 TO 31	32 TO 38	39 TO 46	OVER 46	TOTAL	AVE SPEED
N	1.4	2.4	1.5	0.5	0.4	0.2				6.3	8.1
NNE	0.9	0.8	0.6	0.9	0.7	0.2	0.2	0.1		4.4	13.2
NE	1.5	0.9	0.5	0.4	0.3	0.1				3.6	7.6
ENE	0.5	0.3	0.1	0.1	0.1					1.0	6.1
E	0.9	0.3								1.3	3.1
ESE	0.3	0.2	*							0.5	3.9
SE	1.1	0.7	0.2	0.1	0.1					2.3	5.2
SSE	0.7	1.5	1.5	1.6	0.3					5.6	10.0
S	1.3	3.9	3.6	1.6	0.1					10.4	7.9
SSW	1.5	2.1	1.2	0.7	0.2					5.8	7.1
SW	2.0	2.5	1.1	0.9	0.2	*				7.0	7.2
WSW	0.8	0.7	0.6	0.1	0.1					2.2	7.0
W	1.8	1.0	0.2	0.1	*					3.1	4.2
WNW	0.9	0.4	0.3	0.1						2.2	5.2
NW	2.0	1.4	0.9	0.2						5.0	5.4
NNW	1.2	0.9	0.4	0.3	*					2.8	5.8
CALM	16.0									16.0	
TOTAL	55.2	21.1	12.8	7.6	2.5	0.5	0.2	0.1		100.0	6.8

DECEMBER

HOURLY OBSERVATIONS OF WIND SPEED MILES PER HOUR

DIR	1 TO 3	4 TO 7	8 TO 12	13 TO 18	19 TO 24	25 TO 31	32 TO 38	39 TO 46	OVER 46	TOTAL	AVE SPEED
N	2.3	2.1	0.6	0.6	0.3	*	*			5.6	6.8
NNE	0.6	1.1	0.7	0.6	0.4	1.1	0.4	0.4	0.2	5.7	17.7
NE	1.0	1.2	0.4	0.5	0.1	0.3	*			3.5	8.7
ENE	0.3	0.1	*							0.4	5.1
E	0.7	0.4								1.1	3.3
ESE	0.1	0.1								0.2	2.0
SE	0.7	0.4	0.3	0.2	0.1					1.6	6.4
SSE	0.7	1.4	2.6	2.6	0.4					7.9	10.7
S	1.4	1.1	4.7	1.6	0.2					11.3	8.4
SSW	1.4	2.1	2.1	1.0	0.1	*				6.8	7.7
SW	2.7	3.3	1.5	0.5	0.2					8.2	6.1
WSW	1.0	0.6	0.2	0.1	*					1.9	5.1
W	1.8	0.7	0.1	0.2	0.1					2.9	4.9
WNW	0.6	0.5	0.1	0.1						1.2	4.5
NW	1.9	1.6	0.2	0.1	*	*				3.7	4.7
NNW	1.1	1.2	0.5	*	*					2.9	5.3
CALM	34.3									34.3	
TOTAL	53.1	20.1	14.2	8.4	1.9	1.4	0.5	0.4	0.2	100.0	5.4

the lake can continue to influence the wind patterns in the valley year round. The strongest winds on the average are from the north quadrant and occur during January. Calm conditions occur frequently with the greatest occurrences falling during November and December (approximately 35 percent of the time). These are the months consequently most prone to experience air stagnation conditions. January, even though one of the months experiencing the strongest winds, also experiences a high frequency of calm conditions (29 percent). The month with the highest average wind speed is April (3.8 m/sec) whereas the month with the lowest average speed is November (2.2 m/sec).

During the year and one-half sampled under the Columbia Falls study, the data also showed the highest frequency of winds from the south quadrant. These occurred about 24 percent of the time. The southerly winds were least frequent during the winter season (December - February) when snow cover would minimize the lake effect. The wind speeds also demonstrated the strongest winds were from the northeast.

Badrock Canyon Site

The Badrock Canyon site data demonstrates that the site picked was actually too far south to directly measure the flow in or out of the canyon (Tables 6 and 7). The data actually shows that the site was being

TABLE 6

SURFACE WIND DIRECTION FREQUENCY (PERCENT)
BADROCK CANYON SITE
Mar. 1977-May 1978

Direction	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	Sp	Su	Fa	Wi	Yr
N	15.7	7.9	16.9	10.2	19.7	-	18.2	23.1	15.8	19.0	20.8	13.4	-	13.0	16.5	14.8	13.4	19.8	17.4	16.4
NNE	1.3	1.7	1.2	7.4	0.3	-	0.0	0.0	5.7	6.9	12.1	7.8	-	6.2	3.7	2.7	5.0	1.2	8.2	4.2
NE	0.0	0.3	6.4	4.0	6.1	-	7.4	6.7	2.0	4.4	1.9	3.4	-	2.2	1.0	2.4	4.7	6.0	3.6	3.9
ENE	0.0	0.0	0.6	3.4	0.0	-	0.0	0.0	0.3	1.9	3.2	2.2	-	4.0	0.3	0.8	2.3	0.1	2.3	1.3
E	2.4	1.7	1.6	2.6	1.7	-	2.7	0.7	0.7	2.0	1.0	1.9	-	3.1	1.3	1.8	2.3	1.4	1.8	1.8
ESE	0.3	0.8	0.0	1.0	0.3	-	0.0	0.0	0.3	0.8	1.0	2.2	-	0.9	1.3	0.7	0.8	0.1	1.3	0.7
SE	3.9	2.2	2.0	3.2	2.3	-	5.6	2.5	0.3	1.1	0.0	2.2	-	3.4	1.0	2.2	2.9	3.2	1.3	2.3
SSE	6.0	11.5	9.0	5.9	0.3	-	0.2	0.0	11.7	7.1	4.8	6.0	-	14.9	8.9	9.6	4.0	2.5	6.3	6.4
S	40.3	29.2	23.6	18.4	29.0	-	27.7	26.1	26.8	18.8	13.1	10.5	-	22.0	31.0	29.0	22.0	26.8	14.8	24.0
SSW	1.8	15.2	6.3	10.0	0.0	-	0.0	0.0	4.7	4.6	8.3	4.8	-	3.7	8.6	7.2	6.6	1.0	5.4	5.4
SW	8.9	9.8	14.1	6.6	18.0	-	7.9	12.2	3.7	4.4	4.2	6.7	-	0.9	2.5	7.5	10.4	8.8	5.2	7.7
WSW	1.3	4.2	1.8	5.3	0.0	-	0.0	0.0	5.7	3.9	3.5	6.2	-	2.2	1.8	2.1	3.5	1.2	4.6	2.8
W	7.3	3.6	5.4	6.0	9.9	-	10.6	14.7	7.0	6.9	5.8	6.4	-	4.0	2.3	4.3	7.3	11.6	6.5	7.0
WNW	0.8	3.4	2.2	5.6	0.0	-	0.2	0.0	2.4	4.7	7.0	7.1	-	2.8	2.1	2.2	3.7	0.6	6.0	3.1
NW	7.1	2.5	5.1	5.4	12.5	-	19.5	13.9	8.0	5.4	6.4	7.4	-	4.4	3.8	4.6	7.8	14.7	6.3	7.8
NNW	2.9	5.9	3.7	4.9	0.0	-	0.0	0.0	4.7	8.1	7.0	11.6	-	12.1	14.0	8.0	3.2	1.0	9.1	6.1

TABLE 7

SURFACE WIND SPEED (m/sec)
BADROCK CANYON SITE
Mar. 1977-May 1978

Direction	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	Sp	Su	Fa	Wi	Yr
N	2.6	1.0	2.0	1.9	0.6	-	0.6	0.5	3.5	2.7	2.1	2.8	-	2.2	2.7	2.1	1.2	1.5	2.5	1.8
NNE	2.0	0.9	1.1	2.0	1.6	-	0.0	0.0	2.9	1.2	2.2	2.4	-	2.5	3.2	1.9	1.8	2.9	1.9	1.4
NE	0.0	0.7	3.7	2.4	1.2	-	2.1	1.0	1.4	2.1	1.4	1.4	-	3.5	1.7	2.4	1.8	1.5	1.6	1.8
ENE	0.0	0.0	1.3	2.3	0.0	-	0.0	0.0	1.6	3.4	1.1	1.9	-	6.2	1.6	3.0	2.3	1.6	2.1	2.2
E	4.2	1.6	4.7	3.3	4.5	-	2.4	0.9	0.7	3.0	1.0	1.8	-	5.2	1.4	3.4	3.9	1.3	1.9	2.6
ESE	1.4	1.2	0.0	1.4	1.4	-	0.0	0.0	1.1	3.4	1.1	1.5	-	2.0	2.2	1.7	1.4	1.1	2.0	1.6
SE	1.8	1.5	2.4	2.0	2.2	-	3.5	3.5	0.9	3.1	0.0	3.2	-	3.3	2.5	2.3	2.1	2.6	3.1	2.5
SSE	7.0	3.6	5.9	4.4	6.8	-	1.8	0.0	6.6	5.2	4.0	4.2	-	4.7	5.0	5.2	5.6	4.2	4.5	4.9
S	5.0	3.5	4.3	4.0	4.2	-	2.8	4.3	4.6	5.8	4.3	3.2	-	4.3	4.5	4.3	4.1	3.9	4.4	4.2
SSW	5.4	3.2	3.5	4.1	0.0	-	0.0	0.0	2.2	2.8	1.4	1.4	-	1.9	3.8	3.6	4.1	2.2	1.9	3.0
SW	2.1	3.5	3.3	4.0	3.6	-	1.6	1.8	2.1	2.4	1.2	1.3	-	2.2	4.5	3.1	3.8	1.8	1.6	2.6
WSW	4.6	2.5	3.1	2.5	0.0	-	0.0	0.0	2.1	1.3	1.1	1.4	-	1.5	2.9	2.9	2.5	2.1	1.3	2.2
W	2.5	2.8	2.4	2.0	2.0	-	1.2	1.4	1.1	1.5	0.9	1.4	-	1.7	2.2	2.3	2.0	1.2	1.3	1.7
WNW	1.1	2.9	1.3	2.3	0.0	-	0.9	0.0	1.1	1.3	0.8	1.8	-	2.8	2.2	2.1	2.3	1.0	1.3	1.7
NW	1.1	1.3	2.4	2.1	1.4	-	1.2	1.0	1.7	1.4	1.0	1.1	-	2.4	1.5	1.7	1.8	1.3	1.2	1.5
NNW	2.6	1.1	2.0	1.7	0.0	-	0.0	0.0	1.5	1.5	0.9	2.3	-	2.4	1.8	2.0	1.7	1.5	1.6	1.7
Ave. Speed All Hours	3.5	2.3	3.4	2.8	2.7	-	1.9	2.1	3.4	2.9	2.1	1.9	-	3.4	3.4	3.2	2.8	2.5	2.3	2.7
Hours	382	356	668	679	345	-	517	597	298	743	313	580	-	322	709					

influenced by the wind moving up and down the east side of the valley. A high frequency of north-south winds occurred during all months sampled. Over the entire period sampled, 36 percent of the winds were from the south quadrant while 26 percent were from the north quadrant. Very seldom did winds blow from the east as would be expected during the nighttime hours. Fairly high wind speeds did occur from the south while the remainder of the directions experienced fairly low wind speeds.

Teakettle Mountain Site

The diurnal flow at the Teakettle Mountain Site demonstrates a pronounced upslope-downslope wind through most of the year (Tables 8 and 9). From March through October the flow is from the north until about 1100 MST when the wind direction shifts to the south-southwest. This direction then prevails until about 1900 MST when again the wind slowly moves to a northerly component. The wind speed changes also with about a 4 m/sec wind at night decreasing to about a 2 m/sec wind during the daytime upslope winds.

The Teakettle Mountain Site monthly data shows a very high frequency of north-south winds moving along the mountain side. Over 37 percent of the winds during the year blow from the north quadrant. Also about 29 percent of the winds blow from the south

TABLE 8

SURFACE WIND DIRECTION FREQUENCY (PERCENT)
TEAKETTLE MOUNTAIN SITE
Feb. 1977-June 1978

Direction	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	Sp	Su	Fa	Wi	Yr
N	43.1	40.1	33.8	23.4	35.5	38.1	33.6	47.8	43.0	27.0	18.2	16.9	16.9	29.4	19.5	29.4	28.4	28.1	34.8	39.3	19.9	30.3
NNE	0.0	0.0	0.5	1.0	2.8	0.0	1.5	0.3	3.9	4.6	8.2	6.6	8.0	5.2	6.1	7.1	6.6	3.8	2.1	2.9	6.8	3.8
NE	2.0	8.3	4.9	2.4	4.4	5.6	5.9	5.3	2.7	5.4	3.9	2.6	4.8	6.5	2.1	2.2	6.0	4.1	5.4	4.5	3.4	4.4
ENE	0.0	0.0	0.0	0.1	0.4	0.0	1.5	0.0	0.4	0.9	3.8	2.3	5.3	3.4	3.0	1.9	1.9	1.1	0.8	0.4	3.2	1.3
E	0.0	1.5	4.1	3.0	3.6	3.0	17.1	4.8	4.1	0.9	3.1	3.9	8.2	6.0	18.2	3.9	2.5	6.6	7.2	3.4	4.1	5.6
ESE	0.0	0.0	0.0	0.3	0.1	0.0	2.7	0.6	2.0	1.3	2.8	4.6	3.4	2.9	4.6	0.6	1.9	1.6	1.0	1.3	3.3	1.7
SE	1.5	0.4	0.0	2.2	2.0	2.7	5.7	0.3	0.3	1.0	1.6	1.9	1.4	1.5	1.8	0.6	1.3	1.2	3.2	0.5	1.7	1.6
SSE	0.0	0.0	0.3	3.7	0.1	0.0	0.3	0.0	0.3	0.6	1.3	2.2	3.1	2.1	0.6	1.0	2.2	1.5	0.4	0.3	1.8	1.1
S	19.8	9.6	10.6	15.8	7.2	9.2	817	7.8	9.7	9.0	5.6	5.7	5.8	6.3	10.2	12.2	4.1	10.8	7.8	8.8	7.0	8.9
SSW	0.0	0.0	5.4	3.1	2.7	0.4	0.1	1.0	13.4	13.9	10.0	11.1	5.1	8.0	13.1	21.5	14.2	9.3	2.7	9.3	8.5	7.6
SW	25.7	26.0	21.5	24.9	16.4	23.1	9.0	15.5	7.4	7.7	6.8	5.0	5.1	5.5	7.1	5.7	12.0	13.8	15.7	10.3	7.6	12.3
WSW	0.0	0.0	0.8	1.6	1.3	0.0	0.0	0.0	0.9	2.5	5.1	5.1	5.1	2.8	1.1	1.6	2.8	1.5	0.7	1.1	4.6	1.9
W	4.5	6.6	0.8	9.8	9.8	7.6	6.2	6.1	4.2	9.8	9.5	9.3	8.9	8.2	3.3	2.8	1.9	5.6	7.1	6.7	8.8	6.8
WNW	0.0	0.0	0.3	0.7	1.7	0.0	0.0	0.3	1.2	5.5	5.9	9.0	7.0	4.3	1.1	0.9	0.6	1.4	0.6	2.3	6.6	2.4
NW	3.5	7.5	5.7	6.0	9.6	10.1	6.7	10.0	3.0	5.8	6.0	5.7	4.8	3.3	3.0	1.6	2.5	4.2	8.0	6.3	5.4	5.8
NNW	0.0	0.0	2.7	2.1	2.3	0.1	1.0	0.3	30.	4.3	8.1	8.2	7.0	4.7	5.3	7.0	5.4	3.9	1.7	2.5	7.1	3.8

TABLE 9

SURFACE WIND SPEED (m/sec)
TEAKETTLE MOUNTAIN SITE

Feb. 1977-June 1978

Direction	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	Sp	Su	Fa	Wi	Yr
N	1.5	2.0	3.4	2.8	3.0	1.4	1.6	3.1	2.5	3.1	3.3	2.8	2.7	2.8	2.9	2.7	2.6	2.8	2.2	2.9	2.7	2.6
NNE	0.0	0.0	1.4	3.8	2.5	0.0	2.9	2.7	2.2	3.2	2.6	2.7	2.0	2.2	2.6	3.0	1.5	2.6	2.3	2.7	2.5	2.5
NE	2.0	5.8	2.8	3.7	2.9	2.8	4.5	2.9	2.4	3.1	2.2	3.2	1.8	1.9	3.5	4.1	2.5	3.6	3.2	2.8	2.4	3.0
ENE	0.0	0.0	0.0	1.6	2.9	0.0	8.7	0.0	4.1	6.2	9.0	6.5	8.7	5.9	6.3	4.6	4.9	4.6	5.5	5.2	8.3	5.9
E	0.0	5.8	8.1	3.6	6.7	6.1	8.4	7.4	6.5	6.1	9.1	11.4	8.1	9.3	8.1	4.9	2.9	6.6	6.0	6.7	9.4	7.2
ESE	0.0	0.0	0.0	1.3	6.8	0.0	7.6	5.2	7.6	10.8	4.9	12.0	7.4	7.2	6.9	2.8	6.2	4.6	6.9	7.9	8.9	7.1
SE	3.6	7.5	0.0	6.1	5.6	6.3	7.2	6.1	1.6	6.1	3.8	5.7	3.7	2.5	4.7	4.0	3.3	5.0	5.6	4.6	4.4	4.9
SSE	0.0	0.0	2.3	3.7	1.6	0.0	4.5	0.0	2.0	2.5	1.6	1.4	2.1	2.2	3.7	2.2	3.1	2.8	3.1	2.2	1.7	2.4
S	3.5	3.8	3.2	3.9	2.8	2.6	3.4	2.5	2.7	2.7	1.7	1.6	1.8	2.4	3.5	2.8	1.7	3.3	2.6	2.6	2.2	2.7
SSW	0.0	0.0	3.7	3.8	3.6	2.6	5.0	1.6	3.7	3.9	3.1	2.8	1.9	3.2	3.7	3.2	2.2	3.5	3.4	3.1	2.8	3.2
SW	3.6	4.7	3.5	3.5	3.3	3.0	3.1	2.5	2.6	3.9	3.8	3.1	2.2	2.8	2.9	2.9	1.4	3.4	2.7	3.0	3.4	3.1
WSW	0.0	0.0	2.9	2.0	1.8	0.0	0.0	0.0	1.8	2.8	2.3	3.2	2.2	2.5	2.3	2.3	0.0	2.4	1.4	2.3	2.6	2.2
W	2.2	2.6	2.5	2.9	2.6	2.3	2.9	2.2	2.1	2.8	3.6	3.1	2.9	2.7	2.8	1.9	2.0	2.6	2.4	2.4	3.2	2.6
WNW	0.0	0.0	0.9	1.0	3.1	0.0	0.0	2.5	2.3	2.7	2.7	3.2	2.3	2.6	3.5	2.3	1.9	2.1	2.5	2.5	2.9	2.5
NW	1.8	3.2	2.8	2.3	2.8	2.0	3.4	2.6	2.7	2.3	2.3	2.7	2.2	2.3	3.1	2.3	1.6	2.7	2.4	2.5	2.4	2.5
NNW	0.0	0.0	4.0	2.1	2.7	2.7	3.7	1.8	3.4	2.5	2.8	2.7	2.9	2.7	3.6	3.2	3.1	3.1	3.0	2.6	2.8	2.9
Ave. Speed All hrs	3.1	4.2	3.4	3.4	3.1	2.9	4.6	2.9	3.0	3.2	3.4	3.7	3.4	3.2	4.3	3.0	2.2	3.6	3.2	3.0	3.4	2.8
Hours	202	469	367	711	705	732	714	703	662	692	744	741	414	728	704	687	317					

quadrant. This bi-polar wind direction occurs most frequently during the summer and fall seasons. The highest wind speeds on the other hand are from the east averaging about 7 m/sec. The remainder of the directions experience fairly low wind speeds with averages over the year about 2.5 m/sec.

The flow at the surface near Teakettle Mountain demonstrates how the air pollution released by the aluminum plant can be accumulated to the south and southeast of the plant during the night. Then as the sun heats the mountains to the north, the air flow moves to the north carrying the air pollution with it. This continues until near sunset when the northerly flow is set up.

Upper Air Meteorology

Great Falls

Great Falls is situated in north-central Montana about 220 miles southeast of Kalispell and about 50 miles east of the Rocky Mountains. Because of the mountains, the area is subject to strong southwest-west winds, particularly during the winter. During all months except May, July, and August, the prevailing wind direction at the surface is southwest, with average speeds from 6 - 8.5 m/sec at night and 7 - 9.5 m/sec during the afternoon. The least common wind direction is east-southeast to southeast. Calm

conditions occur only about 1% of the time. May, July, and August are the only months where a diurnal variation in wind direction is apparent. In May and August, southwest to west-southwest winds predominate during the night and morning hours, while west winds are most common during the afternoon. In July the prevailing direction at night is from the west, with a strong secondary maximum from the north to northeast. During the day, southwest to west-southwest winds predominate and the secondary maximum disappears.

During all months the average wind veers with height, becoming westerly above 1500 meters msl.* Wind speed increases with height to about 15 m/sec at 2000 meters msl. During nearly all months and at all levels, the strongest average winds are from the most common direction and the weakest average winds are from the least common direction.

Missoula

Missoula is located in western Montana, about 90 miles south of Kalispell. The city is in a valley trending northwest to southeast, which is surrounded by mountains. Several large canyons intersect the valley in the immediate vicinity. The topography of the area exerts a major influence on the surface and

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* Great Falls is at 1100 meters msl.

low-level winds. Except for June and July, the prevailing winds at the surface and through the lowest 200 meters are from the west-northwest to northwest. There is a pronounced secondary maximum from the east-southeast, particularly at night when these winds are almost as common as those from the northwest. The least common wind directions are north-northeast and south-southwest. During June, the prevailing wind is from the southeast with a secondary maximum from the northwest, except during the late afternoon, when northwest to west winds are most common. The least common wind direction during this month is northeast. In July the prevailing wind is east to southeast with a secondary maximum from the northwest during the night. During the afternoon the prevailing wind is northwest with no secondary maximum apparent.

Average wind speeds at and near the surface are much lower in Missoula than in Great Falls, averaging 1-3 m/sec at night and 2-4 m/sec during the afternoon. Calm conditions at the surface are quite common, especially at night, occurring from 15-32% of the time in the morning and 3-24% in the afternoon. October through January have the greatest occurrence of calm conditions, with December being the calmest of all.

Winds aloft in Missoula, as in Great Falls are mainly from the west to west-northwest during all months. The transition zone between near surface type

winds and the westerlies at higher levels appears to be between 1500 and 2000 meters msl.* Wind speeds increase with altitude, increasing to about 10 m/sec at 2000 meters msl.

Lewiston, Idaho

Lewiston is located at the confluence of the Clearwater and Snake Rivers in western Idaho, about 180 miles southwest of Kalispell, Montana. The city is at the bottom of a canyon about 700 meters deep. The airport, where meteorological records are taken, lies south of the city at an elevation of about 150 meters higher than the city.

The prevailing wind direction at and near the surface at Lewiston shows a marked diurnal variation in all months except December, January, and February. During the night and early morning the wind most often flows from the east, while during the afternoon west winds are most common. This variation is most likely an upslope-downslope condition, with cooler air moving downward into the canyon at night from the higher elevations to the east, and hotter air flowing up the canyon in the afternoon from lower elevations to the west. During the winter months, the prevailing winds are from the east night and day, and this probably reflects the common wintertime synoptic condition of higher surface pressures

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*Missoula is at 972 meters msl.

east of the Rockies and lower pressures near the Pacific coast.

Average wind speeds are fairly light, ranging from about 2.5-5.5 m/sec during all months. The lightest winds normally are at night averaging 2.5-3.0 m/sec. However the percentage of calm conditions is lower at night than during the afternoon, reflecting the fact that the nighttime downslope winds, while gentle, are persistent. Calm conditions are least common in April and May, 5-11 percent, and most common in October and November, 6-34 percent, when strong, stagnant high pressure systems frequently form over this region.

Winds aloft at Lewiston are from the south at 1000 meters msl*, southwest at 1500 meters msl, and west at 2000 meters msl. Below 1400 meters msl, wind directions are similar to surface conditions. There is little month-to-month variation in these values. Wind speeds increase with height and are typically about twice the surface value at 2400 meters msl. Wind speeds at all levels are greatest in the winter and least during the summer.

Spokane

Spokane is located in western Washington, about 160 miles west-southwest of Kalispell, Montana. The city is located near the eastern edge of the Columbia River Basin in an area of rolling foothills. Higher

*Lewiston is at 431 meters msl.

mountains are located to the east.

Surface and near-surface wind directions show a strongly diurnal pattern, blowing predominantly from the south at night and from the southwest during the afternoon during most months. The exceptions to this pattern are in January, September, October and December, when the prevailing nighttime wind is from the east-northeast; November, when the prevailing nighttime wind is from the south-southwest; and August and September when the prevailing afternoon wind is from the west-southwest. During those months when the prevailing nighttime wind is from the east-northeast, a secondary maximum of wind direction from the south is apparent. The percentage of calm conditions is low, ranging from 0.3 to 3.2 percent. This is much lower than in Lewiston or Missoula, but not as low as Great Falls. The least common wind directions are west-northwest to northwest during all months.

Average wind speeds at and near the surface in this area range from 2.9-6.1 m/sec in the mornings and 4.4-6.8 m/sec during the afternoons. The windiest months are January and November while the least windy are September and December.

The average wind aloft in Spokane veers with increasing height, becoming southerly at 1000 m msl*, southwesterly at 1500 meters msl, and from the west-southwest

*Spokane is at 722 meters msl.

at 2000 meters msl. These directions prevail during every month except October and December, when the prevailing direction at 2000 meters msl is from the southwest. Wind speeds increase with height, becoming approximately twice their surface value at 1500 meters msl, but remaining at about that speed up to 2500 meters msl.

Summary

The average wind direction at levels above about 1500 meters msl, is southwest-west for all four sites. Average wind speeds at these levels are also similar, ranging from about 8-13 m/sec, with the greatest average speeds occurring during the winter and the smallest in summer.

At and near the surface all stations except for Great Falls show a significant diurnal variation in wind direction, due mainly to upslope-downslope flow. Lewiston, Idaho shows the most marked variation. Air movement is greatest at Great Falls and least in Missoula. All sites west of the mountains show quite low average wind speeds and a high frequency of calm conditions, especially in the autumn and winter months. Consequently dispersion will be slower and air quality poorer west of the mountains.

Columbia Falls Upper Air

Pilot balloons were launched from the Columbia Falls Teakettle Mountain site from February through October, 1977 (Appendix A). This site is located about 2 miles north-northwest of the Anaconda Company aluminum plant at an elevation of 1000 meters. Teakettle Mountain rises to 1800 meters just east of the site. To the west and south lies the Flathead valley, which is about 15 miles from east to west and 90 miles north to south. Flathead Lake lies 20 miles to the south.

The prevailing winds at this site from the surface to 1230 meters msl* show little variation either monthly or diurnally. Except for September and October, surface winds were from the south or southwest during both morning and afternoon. At 1030, 1130 and 1230 meters msl, prevailing winds were from the south-southwest or south. During September and October surface winds were mainly from the north in the mornings, from the south in the afternoons in September, and from the west during October afternoons. In October, winds at 1030, 1130 and 1230 meters msl were predominantly from the west and northwest during the afternoons and from the south-southwest and west during the mornings. During all months at these lower levels there is a secondary maximum of wind frequency from the north during the mornings.

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*Columbia Falls is 930 meters msl

This secondary maximum is absent during the afternoons, and so probably represents a diurnal upslope-downslope phenomenon.

At the 1430, 1680, and 1930 meter msl levels, the prevailing wind during all months, both morning and afternoon, is from the south to southwest, except for February mornings at 1680 meters msl southeast, and May afternoons at 1930 meters msl west.

The least common wind directions at this site, at all levels and during all months are northeast to east.

Average wind speeds at and near the surface ranged from about 2-5 m/sec. Wind speeds were slightly greater in the afternoons than in the mornings, except during September and October, and were greatest in the spring and least in the autumn. The lowest average wind speeds were at the 1030 meter msl level and increase with height, becoming 8-12 m/sec at 1930 meters msl. At upper levels the highest average wind speeds occurred during the summer and the lowest during the autumn.

In general, the highest wind speeds were from the south to southwest and the lowest were from the northeast to east.

Summary

In Columbia Falls, as in the other cities examined, low-level winds are primarily influenced by topography, in this case the proximity of this site to Teakettle

Mountain. Although only levels up to 1930 meters msl were examined at Columbia Falls, it appears that there is a tendency for the average wind to veer with increasing height, as it does at the other cities in the region. Average wind speeds at Columbia Falls appear to be similar to those at Missoula, Lewiston, and Spokane, but less than Great Falls.

Acoustic Radar

An acoustic radar was operated at the Glacier International Airport from October 1976 through May 1978. Listings and freqeuncy analyses for first and second inversions are included in Appendix A.

The Glacier International Airport is located in the Flathead Valley nine miles southwest of the Teakettle Mountain site and eight miles north-northeast of Kalispell, at an elevation of 906 meters.

An examination of the acoustic radar summaries shows that inversions are almost always present during the night in all months. The typical nighttime (0000-0600 MST) inversion is a surface-based radiation type and is between 100 and 300 meters thick. Very few of these inversions are more than 300 meters thick, with 30-45 percent of surface-based inversions less than 100 meters thick. Elevated inversions are very uncommon during this period. Those that occur are almost always

less than 100 meters thick, with bases less than 300 meters above the ground.

During the period 0600-1200, inversions are present most of the time, except for the months April through September, inclusive. Most of these inversions are surface-based radiation type, and from 100 to 300 meters thick. During the spring and summer months, the nighttime inversion generally disappears by 0600. The only exceptions to this pattern during the course of this study were August and September 1977. During August, inversions were present during this period about 60 percent of the time. About two-thirds of these were elevated inversions less than 100 meters thick and most of the remainder were surface-based from 100 to 300 meters thick. In September, inversions were present about 78 percent of the time. Almost all of these were elevated inversions less than 100 meters thick, with bases between 100 and 400 meters. Except for these two months, elevated inversions were very uncommon during this time period. These autumn and winter inversions were mostly elevated and less than 100 meters thick, although there were a significant number of surface-based inversions, most of which were 100-300 meters thick. The average frequency of occurrence of inversions was 5-15 percent in October and March, and 25-55 percent in November through February.

During the period 1800-2400 MST inversions were present most of the time during all months. These were generally radiation type inversions which were surface-based and 100-300 meters thick. A significant number, however, were less than 100 meters thick, reflecting the fact that radiation-type inversions tend to start thin and thicken with time. Elevated inversions were quite uncommon during this time period, accounting generally for less than 20 percent of all inversions present. These were mostly less than 100 meters thick with bases from 100 to 400 feet above ground level.

Second inversions were quite uncommon during all months, occurring from 0-14 percent of the time. There was no monthly or seasonal variation in frequency of occurrence apparent. These inversions were most common during the nighttime hours and least common during the afternoon. They were most commonly identified as subsidence inversions. Virtually all of these inversions were less than 100 meters thick, with bases from 200-400 meters above ground level. Only one inversion of this type greater than 100 meters thick was noted during the nineteen months of this study.

A list of monthly averages of inversion formation and lifting times, together with the average rate of rise of inversions, is included in Table 10. This data indicates that inversions generally formed from

TABLE 10

INVERSION FORMATION AND LIFTING TIMES

Month	Inversion Formation Time*	Inversion Lifting Time*	Rate of Rise of Inversion (m/2hr)
Nov., 1976	1835	1056	217
Dec.	1825	1017	200
Jan., 1977	1842	1102	181
Feb.	ND+	ND	ND
Mar.	1820	0808	202
Apr.	1937	0750	243
May	2035	0750	256
June	2110	0745	221
July	2047	0740	233
Aug.	2050	0810	196
Sept.	2007	0817	260
Oct.	1937	1017	220
Nov.	1657	1010	205
Dec.	1808	1119	194
Jan., 1978	1658	1222	199
Feb.	1738	1226	177
Mar.	1752	0932	184
Apr.	1850	0822	235
May	1850	0840	230

*Mountain Standard Time

+No data

1½ to 2½ hours after sunset in the winter, but only about one-half hour after sunset during thesummer. The lifting time of inversions showed a similar pattern. The difference in formation times from winter to summer may be due in part to the greater cloud cover found in this area in winter, which would tend to retard radiational cooling near the surface. Also the difference in formation times may be partly due to the steeper lapse rate (greater temperature decrease with height) near the surface in the summer toward afternoon. The situation found in summer would result in a greater temperature change in a lapse rate for a given amount of heat loss due to radiational cooling than would the smaller lapse rate normally found in the winter. Therefore, an inversion can form faster in the summer than in the winter.

The rate of rise of the inversion as it lifted off the surface was calculated in units of meters of rise per two hours in order to facilitate the reduction of data. These values show a seasonal trend from winter to summer with wintertime inversions lifting more slowly than those in summer, typically from 180-200 meters per two hours in winter versus 220-260 meters per two hours in summer. This is probably a consequence of the slower heating in winter, due to increased cloudiness and lower solar elevation angle.

III. TEAKETTLE MOUNTAIN AIRFLOW

Introduction

One important phase of the Columbia Falls Meteorological Study was to investigate and attempt to describe the airflow on the western edge of the Teakettle Mountain. The mountain is of interest as the Anaconda Company aluminum plant is located at the southwest corner of the mountain. Dispersion of fluoride and particulate emissions from the aluminum plant are greatly affected by the mountain airflow.

The airflow was studied using pilot balloons launched from the Teakettle Mountain site (see Appendix B). The balloons were tracked until out of sight on four to five days a month from February through October, 1977. This discussion will examine some of the individual days of the airflow study.

Two morning and afternoon pibal runs from each season except winter were examined in some detail. An attempt was made to select days during which the synoptic conditions were relatively undisturbed by frontal passages, storms, etc. These selection criteria resulted in the elimination of all days made in February, 1977, the only winter month of this study. However, suitable days

were available for all other seasons.

For each day considered, the synoptic conditions, surface wind pattern, inversions, and stability are discussed. A description of the winds aloft encountered by the balloon is presented, and the wind speed and direction is plotted as a function of height.

Discussion of Results

From the morning pibal runs examined, there is evidence of a morning downslope flow from the north. This flow is generally from one to three hundred meters thick, approximately the same thickness as the morning inversion generally found over this area. The stability of this layer is generally neutral to slightly stable during the mid-morning hours. Above this layer, the wind generally, but not always, is from the northwest through southeast in a layer of one to two hundred meters thickness. Above five hundred meters above ground level,* the wind is generally from the southwest through northwest, reflecting the general prevailing upper level winds over this region.

During the afternoon days considered, the southwesterly winds at the surface were found to be generally confined to the lowest fifty or one hundred meters Above this level, in most cases, the wind shifted to become east through southeast up to about 250 to 300 meters above ground level, above which they became

*All references to height in this section are above ground level.

southwesterly again. This effect may be due to a deflection of the wind due to the presence of Teakettle Mountain just to the east. Any pollutants from the aluminum plant to the south would tend to be carried northwest parallel to Teakettle Mountain, until they reached an elevation of about 300 meters above ground level, at which time they would drift toward and eventually over the mountain.

Airflow Case Studies

March 23, 1977: 1015 MST

The surface chart for 0500 MST showed a stationary arctic front lying approximately on a Cut Bank to Miles City line. An occluded front extended northward into Central British Columbia from a low centered west of Spokane. A cold front stretched from this low southward through eastern Oregon and then curved westward to just north of San Francisco. In Central and western Montana skies were clear to partly cloudy. Winds were light and temperatures were generally 0 to 5 degrees C. Surface pressures were generally about 1004 millibars and falling moderately.

At the 500 millibar level a ridge was centered over Montana with a height of about 550 meters over the Columbia Falls area. Winds at this level were about 240 degrees at 10 m/sec. The temperature was between -20 and -25 deg. C.

Surface winds were generally light and northerly in the Columbia Falls area throughout the morning, although at the Badrock Canyon site they were westerly for a time.

The acoustic radar at Glacier International Airport indicated the presence of a surface-based radiation inversion about 300 meters thick during the 0600-1200 MST time period. The two-hour stability analysis for the period 1000-1200 MST indicated neutral stability.

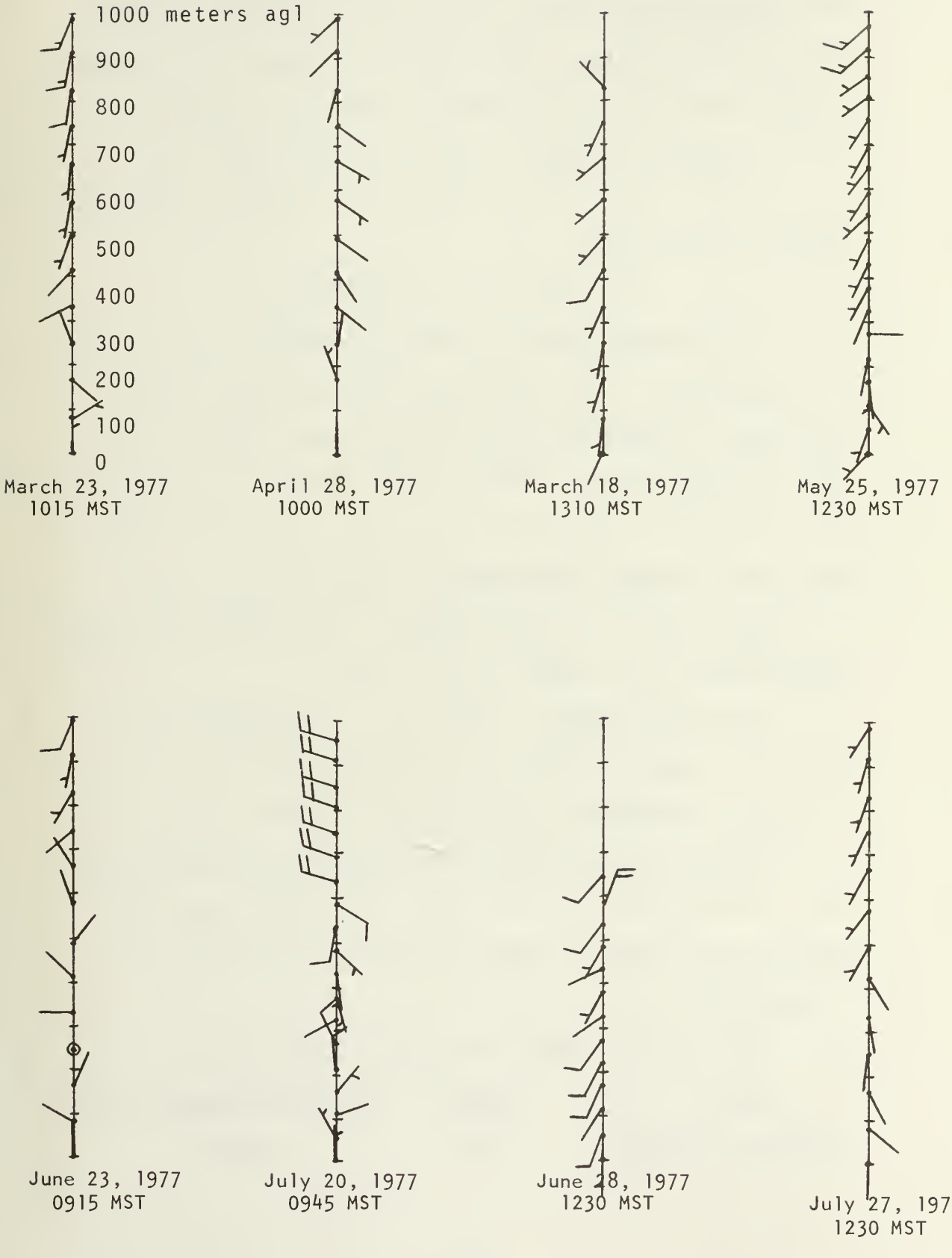
Surface wind speed and direction:

Site	Time	Wind Dir/Speed(m/sec)
Teakettle Mountain (at pibal launch)	1015 MST	360/3.6
Airport (NWS)	1100	340/2.0
Airport (AQB)	1000	340/4.1
	1100	360/3.6
	1200	360/2.7
Badrock Canyon	1000	270/1.4
	1100	270/1.4
	1200	360/1.8
Teakettle Mountain	missing	

After launch, the balloon, ascending at 2.75 m/sec was carried by northeasterly winds up to 50 meters, where it encountered northesterly winds. These winds backed with height, becoming southwesterly at 500 meters and southerly by 660 meters. Above this level, the wind began to veer again, becoming southwesterly at 1075 meters (Figure 2).

TEAKETTLE MOUNTAIN AIRFLOW CASE STUDIES

Figure 2



The most obvious occurrence during this pibal flight was the wind shift from northeast to northwest between 165 and 250 meters. This probably indicates the depth of air involved in the morning downslope wind, and is also probably the depth of the morning inversion, as acoustic radar data indicated an inversion 300 meters thick at this time.

April 28, 1977: 1000 MST

The surface chart for 0500 MST showed low pressure systems centered over northern Nevada and Cut Bank, Montana. A stationary arctic front was located along the eastern border of Montana and a Pacific cold front was approaching the California coast. Sky conditions over the northern intermountain area were scattered to broken middle and high clouds. Winds were light and temperatures were generally 0-5 deg C.

At 500 millibars a weak ridge was present over Montana. Winds at this level were westerly at 17-20 m/sec and temperatures were about -20 deg. C.

Winds at the Kalispell airport during the morning were northerly at 2.7-4.5 m/sec. Both the Teakettle Mountain and Badrock Canyon site wind recorders were inoperative.

The acoustic radar was also inoperative.

Site	Time	Wind Dir/Speed (m/sec)
Teakettle Mountain (at pibal launch)	1000	360/2.3

After launch at 1000, the balloon, ascending at 2.75 m/sec, was blown by northwest-north winds to 250 meters. Above this level the winds were southeast to 250 meters. Above this level the winds were southeast to 750 meters, and southwest above that. Wind speeds were low, from 0.8 to 3.4 m/sec, up to 1000 meters (Figure 2).

Two wind shifts were observed during this sounding. The first, between 250 and 330 meters, was from north to southeast, and probably represents the depth of air involved in the morning downslope flow. The second occurred between 750 and 825 meters, from southeast to southwest.

March 18, 1977: 1310 MST

The surface chart for 0500 MST showed a low pressure system over central Saskatchewan with a cold front extending westward to Edmonton, Alberta and then northwestward into British Columbia. Another low with some associated snow showers was located in western Wyoming. Sky conditions over Montana were scattered to broken middle and high clouds. Afternoon temperatures ranged from 2 to 8 deg. C.

At 500 millibars a long-wave trough was present over the western states with a short-wave over central Alberta moving southeastward. Winds at this level were west-northwest at about 10 m/sec. Temperatures were about -35 deg. C.

Winds in the Columbia Falls area were SW-W at the Teakettle Mountain site, south to southwest at the Badrock Canyon site, and variable at the airport. Wind speeds were 0-3 m/sec.

The acoustic radar showed no inversions present during this period. The two-hour stability analysis for the period 1200-1400 indicated moderately unstable conditions.

Surface wind speed and direction:

Site	Time	Wind Dir/Speed (m/sec)
Teakettle Mountain (during pibal launch)	1310	200/2.3
Airport (NWS)	1400	calm
Airport (AQB)	1300	45/2.7
	1400	270/3.2
Badrock Canyon	1300	180/3.2
	1400	225/2.7
Teakettle Mountain	Inoperative	

The pibal sounding, with a balloon ascent rate of 2.75 m/sec, indicated that winds, which were southwest at launch, became southerly at 80 meters, remained south to southwesterly to 410 meters, and then became southwesterly to 750 meters. At the end of the run at 825 meters the wind was from the northwest. Wind speeds ranged from 2.3 to 11.9 m/sec, with the lowest speed at the surface and the highest at 413 meters. The only wind shift observed, from southwest to northwest,occurred between 750 and 825 meters (Figure 2).

May 25, 1977: 1230 MST

The 0500 MST surface chart showed a low pressure system in eastern Montana with cold front extending from central Saskatchewan southward through the low into eastern Wyoming and Colorado. A high pressure system was centered in southern British Columbia. A few rainshowers were present along the eastern slopes of the Rockies in Montana. West of the mountains, skies were scattered to broken with low and middle clouds. Temperatures ranged from 3 to 6 deg. C.

At 500 millibars a long-wave trough was located over the west coast. Winds at this level over Montana were south-southwest at about 12 m/sec. Temperatures were -15 to -20 deg. C.

Winds in the Columbia Falls area were from the south through west-southwest at all sites, with speeds from 1.4-5.0 m/sec.

The acoustic radar showed no inversions present during this period. The two-hour stability analysis for the period 1200-1400 MST indicated slightly unstable conditions.

Surface wind speed and directions:

Site	Time	Wind Dir/Speed (m/sec)
Teakettle Mountain (during pibal launch)	1230	225/2.7
Airport (NWS)	1400	190/5.0
Airport (AQB)	1200	180/1.8
	1300	225/2.3
Badrock Canyon	1200	250/1.4
	1300	200/2.5
Teakettle Mountain	1200	180/2.7
	1300	180/3.2

This sounding, with a balloon ascent rate of 1.78 m/sec., showed southwest winds at the surface, backing with height to become southeast at 160 meters. Above this height the wind began to veer back toward the southwest except around 270 meters when it briefly blew from the east. Above 320 meters the wind was southwesterly up through 1000 meters (Figure 2).

June 23, 1977: 0915 MST

The surface chart for 0500 MST showed a Pacific cold front extending from a low in west central Manitoba south through Bismarck, North Dakota and then southwest through Casper, Wyoming and Winnemucca, Nevada. A high pressure system was centered in southern British Columbia just north of Kalispell.

The 500 millibar chart shows zonal flow over the region with westerly winds of about 16 m/sec and temperatures of -10 to -15 deg. C.

Sky cover over the region consisted mostly of scattered high clouds. Winds were light, mainly from the north and northwest.

Surface winds in the Columbia Falls area were light, from 0.7 to 3.2 m/sec, and from the north at the Teakettle Mountain site and from the southeast through south at the Badrock Canyon and airport sites.

The acoustic radar showed no inversion present over the area. The two-hour stability analysis for the period 0800-1000 indicated slightly unstable conditions.

Surface wind speed and direction:

Site	Time	Wind Dir/Speed (m/sec)
Teakettle Mountain (at pibal launch)	0915	360/2.3
Airport (NWS)	0800	120/1.5
	1100	140/4.0
Badrock Canyon	0900	126/0.7
	1000	180/1.1
Teakettle Mountain	0900	45/2.3
	1000	360/3.2
Airport (AQB)	not available	

The pibal sounding, with a balloon ascent rate of 2.75 m/sec., showed that the wind, which was northerly at the surface, became northwesterly at 80 meters, switched back to northeasterly at 165 meters, and then became westerly to northwesterly up through 410 meters. After coming briefly from the northeast at 500 meters, the wind was from the northwest from 480 through 660 meters, and then became south through southwesterly

through the remainder of the sounding. No clear pattern is evident here, except for the shift in wind direction from northwest to southwest between 660 and 750 meters (Figure 2).

July 20, 1977: 0945 MST

The surface chart for 0500 MST showed a high pressure system centered near Calgary, Alberta, and a cold front running from Cheyenne, Wyoming, through Pocatello, Idaho and Winnemucca, Nevada. Skies were clear to scattered over the region west of the Rockies, with only a few middle clouds noted. Winds were light, and temperatures ranged 6 to 12 deg. C.

At 500 millibars the flow was from the southwest at about 15 m/sec. Temperatures at this level were -10 to -15 deg. C.

Surface winds in the Columbia Falls area were from the northwest through northeast at all sites. Speeds ranged from 2.0-6.8 m/sec.

The acoustic radar indicated the presence of a radiation type inversion aloft, with a base at 300 meters and about 100 meters thick. The two-hour stability analysis indicated slightly unstable conditions in the lowest 100 meters.

Surface wind speed and direction:

Site	Time	Wind Dir/Speed (m/sec)
Teakettle Mountain (at pibal launch)	0945	360/6.8
Airport (NWS)	0800	20/6.5
	1100	300/2.0
Badrock Canyon	not available	
Airport (AQB)	0900	360/3.2
	1000	360/2.7
Teakettle Mountain	0900	360/5.9
	1000	360/5.5

The pibal sounding, with a balloon ascent rate of 1.78 m/sec., indicated that the wind, which was northerly at launch, became northwesterly at 50 meters, and then veered to east-northeast by 100 meters. It then backed with height to become northwest at 270 meters, and then shifted to south-southwest by 375 meters. The wind then varied from southeast to south until 640 meters, when it became westerly and remained so through the rest of the flight. Wind speeds were about 6 m/sec near the surface, decreased to 1.3 m/sec at 100 meters and then increased to 9.2 m/sec at 270 meters. Above this level, the wind speed declined suddenly to 1.9 m/sec at 320 meters before beginning to increase again. The wind shift at 640 meters was accompanied by a sharp increase in wind speed to 22 m/sec (Figure 2).

June 28, 1977: 1230 MST

The surface chart for 0500 MST featured a high pressure system centered over Missoula, Montana. A

Pacific front was approaching the Washington coast. Skies over the region were mostly scattered, with middle and high clouds predominating. Winds were light and temperatures ranged from 6 to 12 deg. C.

The flow at 500 millibars was west-northwest at 20-25 m/sec. Temperatures at this level were -10 to -15 deg. C.

Surface winds in the Columbia Falls area were south through southwest at all sites. Wind speeds varied from 4.5 to 8.0 m/sec.

The acoustic radar indicated no inversions present during this period. The two-hour stability analysis indicated slightly unstable conditions.

Surface wind speed and direction:

Site	Time	Wind Dir/Speed (m/sec)
Teakettle Mountain (at pibal launch)	1245	180.6.8
Airport (NWS)	1100	160/7.0
	1400	240/7.0
Badrock Canyon	1200	180/7.0
	1300	207/8.0
Airport (AQB)	not available	
Teakettle Mountain	1200	225/4.5
	1300	225/5.5

The wind, which at the surface was from the south, became south-southwest at 50 meters and remained so up to 500 meters. Above this level the wind varied from south-southwest through west-southwest for the remainder of the sounding. Wind speeds ranged from 1.3 to 13.5

m/sec and were highest at the surface and above about 500 meters. The balloon ascent rate for this sounding was 1.28 m/sec (Figure 2).

July 27, 1977: 1230 MST

At 0500 MST a surface high pressure system was located over western Montana. Skies over the region were clear or scattered, with only a few high clouds noted. Winds were light and temperatures were 10 to 15 deg. C.

At 500 millibars winds were from the west-northwest at 5 to 10 m/sec and temperatures were -10 to -15 deg. C.

Surface winds in the Columbia Falls area were from the southeast through the southwest at speeds from 1.4 to 3.0 m/sec.

The acoustic radar indicated no inversions present during this period. The two-hour stability analysis showed slightly unstable conditions.

Surface wind direction and speed:

Site	Time	Wind Dir/Speed (m/sec)
Teakettle Mountain (at pibal launch)	1230	180.1.4
Airport (NWS)	1100	140/2.5
	1400	150/3.0
Badrock Canyon	not available	
Airport (AQB)	1200	180/missing
	1300	180/missing
Teakettle Mountain	1200	225/1.8
	1300	225/1.8

The pibal sounding, with a balloon ascent rate of 2.75 m/sec., indicated that the wind, which was southerly at the surface, backed with height to become east-southeast at 80 meters, and then veered with height to become southerly again at 330 meters. At 410 meters the wind again was coming from the southeast. Above this level the wind was south-southwest to southwest up through 1000 meters (Figure 2).

September 14, 1977: 0930 MST

The 0500 MST surface chart showed a low pressure system in northcentral Washington with a cold front extending to just south of Calgary, Alberta, from there southeast to around Glasgow, Montana and then northeastward to a low north of Lake Winnipeg. Over Montana skies were clear, winds light, and temperatures were 5 to 10 deg. C.

The flow at 500 millibars was from the west-southwest at about 15 m/sec. The temperature at this level was from -10 to -15 deg. C.

Surface winds around the Columbia Falls area were south through southwest at 4.5 to 8.0 m/sec.

The acoustic radar indicated the presence of an elevated radiation type inversion with a base at 200 meters and a thickness of 300 meters. The two-hour stability analysis for 0800-1000 indicated neutral stability in the lowest 100 meters.

Surface wind direction and speed:

Site	Time	Wind Dir/Speed (m/sec)
Teakettle Mountain (at pibal launch)	0930	360/2.3
Airport (NWS)	0800	calm
	1100	160/3.0
Badrock Canyon	0900	45/1.4
	1000	270/0.9
Airport (AQB)	0900	270/0.9
	1000	225/missing
Teakettle Mountain	0900	360/3.6
	1000	45/2.3

This sounding, with a balloon ascent rate of 2.75 m/sec, indicated that the wind, which was northerly at the surface, became northwesterly at 80 meters, and then veered with height to become southwesterly at 330 meters. Above this level the wind backed to northeasterly at 410 meters and then shifted to westerly up through 580 meters. The wind then became southwesterly up through the 1000 meter level. Apparently, the wind shift at 500 meters from northeast to west marked the top of the elevated inversion. Winds in the inversion layer were from the northeast through southeast, while in the lowest 165 meters, below the inversion, they blew from the north (Figure 3).

October 27, 1977: 1000 MST

The surface chart for 0500 MST shows a high pressure system centered over extreme southeastern Montana. A

cold front stretched across southern Wyoming to a low pressure system in central Nevada. A Pacific cold front was approaching the Washington coast. Over Montana skies were clear, winds light, and temperatures were 0 to -5 deg. C.

At 500 millibars, winds were from the west at 22 to 25 m/sec. and temperatures were about -15 deg. C.

Winds in the Columbia Falls area were from the northwest through northeast from 0.9 to 4.0 m/sec.

The acoustic radar indicated a surface based radiation inversion of 300 meters thickness was present. The two-hour stability analysis for 0800-1000 MST indicated slightly stable conditions, and from 1000-1200 MST neutral conditions prevailed.

Surface wind direction and speed:

Site	Time	Wind Dir/Speed (m/sec)
Teakettle Mountain (at pibal launch)	1000	360/3.2
Airport (NWS)	1100	40/4.0
Badrock Canyon	1000	360/0.9
Teakettle Mountain	1000	315/4.5
Airport (AQB)	missing	

At launch time the wind was from the north. After launch, the balloon, ascending at 1.78 m/sec, encountered winds from the west-northwest up to 50 meters. The wind then remained from west-northwest to northwest up to 160 meters. By 215 meters the wind had shifted to east and remained from northeast through east up through 480

meters. Above this level the wind became northerly briefly, but shifted back to between east and southeast between 640 and 750 meters. At 800 meters the wind again had become northerly and remained so until shifting to the south at 960 meters (Figure 3).

The wind shift at 215 meters from northwest to east probably marked the boundary of the layer involved in the morning downslope flow, and this may also represent the top of the inversion layer. The easterly winds between 215 and 480 meters may represent a secondary downslope flow from the face of Teakettle Mountain. The winds above this level were light and variable, reflecting the presence of a large high pressure system over the area.

September 14, 1977: 1215 MST

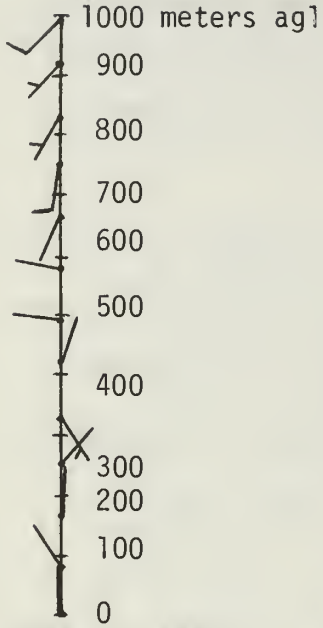
The 0500 MST surface chart showed a low pressure system in north central Washington, with a cold front extending to just south of Calgary, Alberta, from there southeast to near Glasgow, Montana and then northeastward to a low north of Lake Winnipeg. Over Montana skies were clear, winds light, and temperatures were 5 to 10 deg. C.

The flow at 500 millibars was from the west-southwest at about 15 m/sec. The temperature at this level was from -10 to -15 deg. C.

Surface winds in the Columbia Falls area were mostly from the southeast and south, from 1.4 to 3.0 m/sec.

TEAKETTLE MOUNTAIN AIRFLOW CASE STUDIES

Figure 3



September 14, 1977
0930 MST

October 27, 1977
1000 MST

September 14, 1977
1215 MST

October 26, 1977
1300 MST

The acoustic radar indicated no inversion present during this time period. The two-hour stability analysis indicated slightly unstable conditions in the lowest 100 meters.

Surface wind direction and speed:

Site	Time	Wind Dir/Speed (m/sec)
Teakettle Mountain (at pibal launch)	1215	180/2.3
Airport (NWS)	1100	160/3.0
	1400	180/5.0
Badrock Canyon	1200	225/1.4
	1300	360/1.4
Airport (AQB)	1200	180/missing
	1300	180/2.7
Teakettle Mountain	1200	360/1.8
	1300	270/1.8

At the surface the wind was from the south at launch. The balloon ascending at 2.75 m/sec., encountered a southwesterly wind up to 80 meters. At that height the wind shifted to southeast and remained from east through southeast up through 330 meters. The wind then became south-southwest through southwest and remained so up through the 1000 meter level (Figure 3).

October 26, 1977: 1300 MST

The surface chart for 0500 MST showed a low pressure system centered in north central Wyoming with an associated cold front extending to Pocatello, Idaho and then south-westward through Nevada and California. Over Montana skies were mostly broken to overcast with low and middle

clouds. A few showers were present over the western mountains. Temperatures were 0 to 10 deg. C.

At 500 millibars winds were easterly at 32 to 47 m/sec. and temperatures were about -20 deg. C.

Winds in the Columbia Falls area were mostly from the south through southwest at speeds from 2.3 to 6.0 m/sec.

The acoustic radar indicated no inversions present. The two-hour stability analysis for 1200 to 1400 indicated slightly unstable conditions.

Surface wind direction and speed:

Site	Time	Wind Dir/Speed (m/sec)
Teakettle Mountain (at pibal launch)	1300	180/2.3
Airport (NWS)	1100	230/6.0
	1400	10/3.0
Badrock Canyon	1300	180/5.0
Teakettle Mountain	1300	315/3.2
Airport (AQB)	Missing	

Winds at the surface at launch were from the south. The balloon, ascending at 2.75 m/sec, showed the wind veering with height to become westerly by 165 meters. The wind continued to blow from the west-southwest through west through the remainder of the run. Wind speeds, which were 2.0 to 4.0 m/sec. at launch, increased with height to become 10.0 to 14.0 m/sec. above 900 meters (Figure 3).

IV. VISIBILITY STUDY

Introduction

The reduction of visibility can occur by two basic methods, reduction of visual range or atmospheric discoloration. The subject of this study was the reduction of visual range in the area of the Glacier International Airport. As light enters the atmosphere, it can be scattered by small particles, absorbed by gases, or refracted (bent) by particles. As the light is scattered or absorbed, an object becomes less distinct due to a reduction in contrast between the object and the background. When the contrast approaches zero, the object will no longer be visible. In the discussion of visibility impairment, the redirection of light by refraction is considered part of light scattering. This is measured as the scattering coefficient (b_{scat}). The total light extinction (b_{ext}) is characterized by the sum of absorption (b_{abs}) and scattering (b_{scat}). Scattering is dependent on the wavelength of the light and the size of the particles. Scattering is the greatest when the wavelength of the light is approximately the same as the radius of the particle.

In pure air (containing no particles) the scattering coefficient is approximately 1.0×10^{-5} per meter over all

wavelengths together at about the elevation of Kalispell (3000 ft msl). Several methods of converting an extinction coefficient to visual range have been derived. The method derived by Koschmieder (Middleton, 1952) assumes a contrast between the background and the object is two percent, which is usually called the meteorological range. Using this method:

Meteorological Range in meters (MR) = $3.912/b_{ext}$

The Federal Aviation Administration has adopted a contrast of 5.5 percent in calculating range. This is usually termed the visual range which is:

Visual Range in meters (VR) = $2.900/b_{ext}$

Under the Columbia Falls study, visibility data was collected from observations made visually by the National Weather Service (NWS) and from an integrating nephelometer (see Appendix B).

Visibility data has been collected by the NWS for many years at the Glacier International Airport. This data has been tabulated for the period 1965 through 1978 for the days in which smoke reduced the visibility to six miles or less (Table 11). The table shows the number of days each month for each year of visibility impairment due to smoke and the total by year and by month. The data shows a dramatic drop in the occurences of visibility impairment from a high of 54 days in 1969 to 0 days in 1978. Comparing the last six years (1973-1978) with the previous

TABLE 11

DAYS WHEN SMOKE REDUCES VISIBILITY IN
FLATHEAD VALLEY TO 6 MILES OR LESS

Data Taken at Glacier International Airport

Year	'65	'66	'67	'68	'69	'70	'71	'72	'73	'74	'75	'76	'77	'78	14 Year Total
Month															
January				1	1	4	1	1					2		10
February	3	4			15	6	3	3					1		35
March					10	4									14
April				1	1	1	1	1							5
May						1	1	1							3
June															0
July															0
August			3			1	1								5
September				7	1	6					1				15
October	2	6	4	10	11	10	5	9				1			58
November	3	2	5	5	8	8	2	7		5		5			50
December	2	1		1	7	2		1		4	4	2			24
Total	10	13	12	25	54	43	14	23	0	9	5	8	3	0	219

six years (1967-1972) 85 percent fewer smoke impaired days occurred during the 1973-1978 period. The data also demonstrates the late fall and early winter as being the months most subject to smoke problems. This is also the time period experiencing the poorest ventilation conditions (wind and stability).

Looking at more recent data, a comparison was made of the nephelometer measurements of scattering coefficients, visual range, and meteorological range and the visual range estimates by the NWS. The nephelometer was run from October, 1976 through May, 1978. Hourly average scattering coefficients were tabulated and summarized (Table 12). For the nephelometer, measurements are made at about the 0.5 micron wavelength. For this wavelength, the pure air scattering coefficient is about 0.15×10^{-4} per meter at the Kalispell elevation.

The nephelometer samples only the air in the immediate vicinity of the instrument. The instrument therefore does not analyze the visibility as the human observer analyzes it. However, various approximating conversions, as were mentioned previously, are available to estimate visibility from the nephelometer measurements. Table 12 summarizes the nephelometer measurements and the corresponding meteorological range and visual range.

The nephelometer measurements are given in monthly arithmetic averages; minimum one, three, and twenty-four hour values; and number of twenty-four hour values

TABLE 12

NEPHELOMETER MEASURED SCATTERING COEFFICIENT
Glacier International Airport

Values in 1/meters x 10**-4

Month	Arith. Aver.	Min. 1-hr.	Min. 3-Hr.	Min. 24-Hr.	No. of 24-hour Periods <1.0	<0.8	<0.4	Monthly Average Meteorological Range[+] in Miles	Monthly Average Visual Range[a] in Miles
Oct. 76	1.51	0.30	0.30	0.51	8	2	0	16	12
Nov.	1.36	0.20	0.20	0.22	8	5	1	18	13
Dec.	1.35	0.20	0.20	0.37	5	3	0	18	13
Jan. 77*	0.77	0.40	0.43	0.60	3	2	0	32	23
Feb.	1.13	0.30	0.30	0.37	17	13	1	22	16
Mar.	0.56	0.20	0.20	0.27	30	26	6	44	32
Apr.	0.66	0.30	0.30	0.31	19	17	0	37	27
May	0.47	0.20	0.23	0.30	13	13	3	52	38
June	0.50	0.20	0.20	0.24	27	27	6	49	36
July	0.44	0.20	0.20	0.22	17	17	7	55	41
Aug.	0.68	0.30	0.30	0.35	26	16	1	36	27
Sept.	0.76	0.30	0.30	0.40	18	13	0	32	24
Oct.	1.44	0.50	0.50	0.56	5	4	0	17	13
Nov.	1.12	0.40	0.47	0.54	7	3	0	22	16
Dec.	1.43	0.50	0.50	0.55	5	3	0	17	13
Jan. 78	1.67	0.60	0.60	0.64	3	1	0	15	11
Feb.	1.98	0.70	0.70	1.03	0	0	0	12	9
Mar.	1.52	0.70	0.72	0.78	5	0	0	16	12
Apr.	1.11	0.60	0.60	0.71	14	0	0	22	16
May	1.08	0.75	0.75	0.81	15	0	0	23	17

*Less than full month of data
[+]2 percent contrast
[a]Less than 5.5 percent contrast

below certain levels. The data shows a definite trend toward higher scattering coefficients (lower visibility) during the late fall and early winter and lower coefficients in mid-summer. The average summer scattering coefficient is 0.47 x 10**-4 (0.000047) per meter, while the average late fall value is approximately 1.37 x 10**-4 per meter. The diurnal trend shows a pattern of highest scattering coefficients in the early morning and evening. The lowest coefficients occur from 12 noon until 8:00 p.m.

Comparing the scattering coefficients of Table 12 with the monthly stabilities of Table 2, a very close correlation is evident. The frequency of stable meteorology (E and F stabilities) is closely correlated with the scattering coefficients. With more occurrences of stable classification, the scattering coefficients become higher. The opposite is true with less stable classifications (lower scattering coefficients). The diurnal trend also correlates well between scattering and stability. The early morning and evening hours are the most stable hours and consequently have the highest scattering coefficients. The mid-day hours are least stable (unstable, neutral) and also have the lower scattering coefficients.

Since the nephelometer used had an air intake heater, humidity should have had little effect on the measurements.

The meteorological range values vary from a maximum of 55 miles in July, 1977 to a minimum monthly average of

12 miles during February, 1978. The meteorological range is calculated using a 2 percent contrast assumption.

The visual range values (using a 5.5 percent contrast) vary from a maximum of 41 miles in July, 1977 to a minimum of 9 miles in February, 1978.

More detailed investigation was made into the conditions that caused two of the days in which smoke reduced the visibility of the Flathead Valley to six miles or less (Table 11). The two days selected occurred during October and November, 1976 when meteorological data was available. The first day examined was October 7, 1976. Table 13 summarizes the meteorological parameters from 1400 MST on October 7 to 1100 MST on October 8, 1976. (No estimates were available of the amount of slash or open burning occurring during 1976.) During the period from 2000 to 2300 MST the National Weather Service estimated the visibility was reduced to 6 and 4 miles, respectively, due to smoke. During the two previous three-hour periods the visibility was 20 and 25 miles, respectively. The wind speeds were low until 2300 MST when the winds became calm. The stability was neutral to slightly unstable until 2300 MST when the stability became moderately stable. Table 13 also shows the inversion heights and thicknesses covering the period examined. Prior to the low visibility there was no inversion. However, during the smoke problems there existed a surface based inversion

TABLE 13

METFOROLOGICAL CONDITIONS OF OCTOBER 7-8, 1976

Time (MST)	Visibility (miles)	Temp. (F)	Rel. Hum. (%)	Wind Speed (Knots)	Wind Direction	Scat. Coef.*	Stability	Ceiling	Sky Cover
Oct. 7									
1400	25	55	55	3	260	1.5	D	UNL+	0
1700	20	58	48	5	200	1.1	C	UNL	0
2000	6	41	79	4	300	2.1	D	UNL	0
2300	4	34	82	0	0	4.5	F	UNL	0
Oct. 8									
0200	7	30	82	0	0	2.4	F	UNL	0
0500	7	28	82	0	0	4.2	F	UNL	0
0800	3/4	31	85	0	0	3.5	F	UNL	3
1100	15	50	64	3	80	2.0	F	UNL	1

*Values times 10**-4

+Unlimited

INVERSION

Time (MST)	Base Height (m)	Thickness (m)
0601-1200	0	300
1201-1800	No Inversion	
1801-2400	0	200
0001-0600	0	400
0601-1200	0	500
1201-1800	No inversion	

increasing from 200 meters to 400 meters thick. The relative humidities were high during the poor visibility. As the day progressed the poor visibility continued into the morning of October 8. At 0800 MST the NWS reported a visibility of three-quarters of a mile due to fog. The visibility improved to 15 miles at 1100 MST on October 8 when the inversion disappeared. The poor visibility during the smoke problems were due mainly to a surface based inversion and calm winds preventing dispersion of the smoke. During the smoke problems the scattering coefficient of the nephelometer increased from 1.1 to 4.5 x 10**-4 (0.00045), then decreased slowly to 2.0 x 10**-4 at 1100 MST.

The second day examined due to smoke problems was November 8-9, 1976 (Table 14). On this day the NWS reported low visibilities from 2300 MST November 8 through 0800 MST on November 9 due to fog and smoke. The visibility decreased from 15 miles at 2000 MST to less than one mile during the smoke and fog problems. The relative humidities again were high, around 95 percent until after the problems. Wind speeds dropped from 5 knots to calm until 1400 MST when the wind picked up to 3 knots. The stabilities again were slightly to moderately stable until 1400 MST when they became neutral. During the same period the nephelometer measured scattering coefficient increased very little from 0.8 x 10**-4 at

TABLE 14

METEOROLOGICAL CONDITIONS OF NOVEMBER 8-9, 1976

Time (MST)	Visibility (miles)	Temp. (F)	Rel. Hum. (%)	Wind Speed (Knots)	Wind Direction	Scat. Coef.*	Stability	Ceiling	Sky Cover
Nov. 8									
2000	15	40	93	5	260	0.8	F	UNL+	2
2300	1/16	32	92	0	0	1.0	M	10	10
Nov. 9									
0200	4/16	32	96	0	0	1.0	E	2	10
0500	4/16	27	92	0	0	1.3	E	UNL	8
0800	1	25	92	0	0	1.3	E	UNL	5
1100	6	40	86	0	0	1.3	F	UNL	3
1400	10	50	64	3	270	1.3	D	UNL	0
1700	20	47	68	3	230	1.7	D	28	6
2000	12	39	82	0	0	1.8	E	22	10
2300	12	40	79	4	50	2.0	E	19	10

*Values times 10**-4

+Unlimited

INVERSION

Time (MST)	Base Height (m)	Thickness (m)
1201-1800	200	100
1801-2400	0	100
0001-0600	0	200
0601-1200	0	400
1201-1800	300	100
1801-2400	100	100

2000 MST on November 8 to 1.0 x 10**-4 during the lowest visibility. This appears to demonstrate the poor visibilities were due primarily to fog and not smoke particles. The inversion data recorded a surface based inversion from 1800 MST on November 8 through 1200 MST on November 9.

Further examination was also made of the days experiencing high and low average scattering coefficients for the day as measured by the nephelometer (Tables 15 and 16). The days picked were July 17, 1977 (low scattering coefficient) and February 23, 1978 (high scattering coefficient). July 17, 1977, was a fairly cool summer day with some rain occurring during the evening hours (2000 and 2300 MST). The visibilities as estimated by the NWS varied from 12 to 50 miles with the lowest visibility occurring during the rain. The winds were moderate from the south. During the early morning hours a shallow surface inversion existed which disappeared at 0600 and then reappeared that evening. Stabilities were generally slightly stable during the inversion occurrence and neutral throughout the rest of the day. The nephelometer measurements started the day at 0.6 x 10**-4. As the stability improved, the scattering coefficients improved to 0.2 x 10**-4 at mid-day. Again towards nighttime the scattering coefficients increased slightly.

On February 23, 1978, the nephelometer recorded some of the highest scattering coefficients of the study. The day was subject to deep surface based inversions all day. Stabilities, therefore, remained as slightly stable throughout the day. The winds were

TABLE 15

METEOROLOGICAL CONDITIONS OF JULY 17, 1977

Time (MST)	Visibility (miles)	Temp. (F)	Rel. Hum. (%)	Wind Speed (Knots)	Wind Direction	Scat. Coef.*	Stability	Ceiling	Sky Cover
0200	20	70	32	10	210	0.6	E	120	10
0500	40	62	58	8	160	0.3	D	90	10
0800	50	62	63	11	150	0.3	D	55	10
1100	50	63	58	8	180	0.2	D	55	10
1400	40	65	52	7	180	0.2	D	50	10
1700	45	63	63	6	170	0.2	D	55	10
2000	30	59	61	6	170	0.3	E	55	10
2300	12	57	63	8	180	0.3	E	41	10

*Values times 10**-4

INVERSION

Time (MST)	Base Height (m)	Thickness (m)
0000-0600	0	100
0601-1200	No inversion	
1201-1800	No Inversion	
1801-2400	0	200

TABLE 16

METEOROLOGICAL CONDITIONS OF FEBRUARY 23, 1978

Time (MST)	Visibility (miles)	Temp. (F.)	Rel. Hum. (%)	Wind Speed (Knots)	Wind Direction	Scat. Coef.*	Stability	Ceiling	Sky Cover
0200	1/4	24	81	0	0	4.4	E	75	10
0500	1/16	24	85	3	250	3 5	E	1	10
0800	1/4	26	88	0	0	3.9	E	55	10
1100	2	28	85	0	0	4.1	E	55	10
1400	10	33	75	0	0	3 3	E	45	10
1700	25	35	76	3	130	2.7	E	90	10
2000	20	30	75	4	240	2.6	E	100	8
2300	20	30	78	0	0	2.3	E	100	10

*Values times 10**-4.

INVERSION

Time (MST)	Base Height (m)	Thickness (m)
0000-0600	0	600
0601-1200	0	500
1201-1800	0	400
1801-2400	0	200

calm most of the day with brief light winds early in the morning and then again toward evening. Visibilities, as estimated by the NWS, started the day at ¼ mile but improved to 10 miles at 1400 and 25 miles at 1700. The nephelometer measurements started the day at 4.4 x 10**-4 and slowly improved to 2.3 x 10**-4 at 2300 MST. The dramatic increase in visibility at 1700 as observed by the NWS coincided with a narrowing of the surface based inversion from 400 meters to 200 meters and also an increase in wind speed. The scattering coefficients did not show a dramatic change as the NWS observations indicating the visibility obstruction was due mainly to water droplets or fog. The NWS data supported the nephelometer measurements as they reported fog from 0200 to 1100 MST.

V. SUMMARY AND RECOMMENDATIONS

The meteorological study of the Columbia Falls area produced important data relating to the air pollution potential of the northern Flathead Valley. Measurements relating to stability; inversion height, thickness, duration, and type; surface wind direction and speed; and upper level wind direction and speed were made over a period of 18 months. The study filled a void relating to the air pollution potential of the area. Very little previous data was available in the area relating to these parameters.

Measurements of upper level wind also revealed the circulation of the winds around Teakettle Mountain. Fluoride pollution released from the Anaconda Company aluminum plant can now better be tracked as to the movement up or down the mountain area.

Visibility measurements also produced very meaningful results. The long-term data has shown a dramatic decrease in smoke problems of the northern Flathead Valley. Data on individual case studies of recent days of reported smoke problems was shown to be largely water droplets of fog.

The study did not cover some important areas of air

pollution potential and visibility due to lack of resources. In the area of air pollution potential data should be obtained in the future on inversion strengths, lapse rates below inversions, and mixing heights. Related to visibility, measurements need to be made on concentration of small particles, water vapor effects on visibility, and relative visibility impairment of various sized particles. A study being conducted presently by the Air Quality Bureau under the Flathead Environmental Study will attempt to address these areas.

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APPENDIX A

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY — MONTH OF OCTOBER 1976

FIRST INVERSION

DAY	0000-0600 MST BASE (100M)	TOP (100M)	TYPE *	0601-1200 MST BASE (100M)	TOP (100M)	TYPE *	1201-1800 MST BASE (100M)	TOP (100M)	TYPE *	1801-2400 MST BASE (100M)	TOP (100M)	TYPE *
1	M	M	M	M	M	M	M	M	M	M	M	M
2	M	M	M	M	M	M	M	M	M	M	M	M
3	M	M	M	M	M	M	M	M	M	M	M	M
4	M	M	M	M	M	M	M	M	M	M	M	M
5	M	M	M	M	M	M	M	M	M	M	M	M
6	M	M	M	M	M	M	M	M	M	M	M	M
7	0	3	4	0	3	4	N	N	N	0	2	4
8	0	4	4	0	5	4	N	N	N	0	3	4
9	0	4	4	0	3	4	N	N	N	0	3	4
10	0	3	4	0	2	4	N	N	N	0	1	3
11	0	2	3	0	2	3	N	N	N	0	3	4
12	0	2	3	0	2	4	N	N	N	0	2	4
13	0	3	4	0	2	4	N	N	N	0	1	3
14	0	2	3	N	N	N	N	N	N	0	2	3
15	0	2	3	N	N	N	N	N	N	0	3	4
16	0	4	4	0	4	3	N	N	N	0	2	3
17	N	N	N	N	N	N	N	N	N	0	2	3
18	0	3	4	0	4	4	N	N	N	0	2	4
19	0	4	4	1	4	3	N	N	N	0	2	4
20	0	4	4	2	5	3	N	N	N	0	3	4
21	0	4	4	0	4	4	N	N	N	0	3	4
22	M	M	M	M	M	M	M	M	M	M	M	M
23	N	N	N	0	3	3	N	N	N	0	2	4
24	0	4	4	0	4	4	1	3	3	0	2	3
25	N	N	N	N	N	N	N	N	N	0	2	3
26	M	M	M	M	M	M	M	M	M	M	M	M
27	M	M	M	M	M	M	M	M	M	M	M	M
28	M	M	M	M	M	M	M	M	M	M	M	M
29	N	N	N	N	N	N	N	N	N	0	2	3
30	0	2	4	0	4	4	2	3	3	0	2	4
31	M	M	M	M	M	M	M	M	M	M	M	M

SECOND INVERSION

DAY	0000-0600 MST BASE (100M)	TOP (100M)	TYPE *	0601-1200 MST BASE (100M)	TOP (100M)	TYPE *	1201-1800 MST BASE (100M)	TOP (100M)	TYPE *	1801-2400 MST BASE (100M)	TOP (100M)	TYPE *
1	M	M	M	M	M	M	M	M	M	M	M	M
2	M	M	M	M	M	M	M	M	M	M	M	M
3	M	M	M	M	M	M	M	M	M	M	M	M
4	M	M	M	M	M	M	M	M	M	M	M	M
5	M	M	M	M	M	M	M	M	M	M	M	M
6	M	M	M	M	M	M	M	M	M	M	M	M
7	N	N	N	N	N	N	N	N	N	N	N	N
8	N	N	N	N	N	N	N	N	N	N	N	N
9	N	N	N	N	N	N	N	N	N	N	N	N
10	N	N	N	N	N	N	N	N	N	N	N	N
11	N	N	N	N	N	N	N	N	N	N	N	N
12	N	N	N	N	N	N	N	N	N	N	N	N
13	N	N	N	N	N	N	N	N	N	N	N	N
14	N	N	N	N	N	N	N	N	N	N	N	N
15	N	N	N	N	N	N	N	N	N	N	N	N
16	N	N	N	N	N	N	N	N	N	N	N	N
17	N	N	N	N	N	N	N	N	N	N	N	N
18	N	N	N	N	N	N	N	N	N	N	N	N
19	N	N	N	N	N	N	N	N	N	N	N	N
20	N	N	N	N	N	N	N	N	N	N	N	N
21	N	N	N	N	N	N	N	N	N	N	N	N
22	M	M	M	M	M	M	M	M	M	M	M	M
23	N	N	N	N	N	N	N	N	N	4	5	9
24	N	N	N	N	N	N	N	N	N	N	N	N
25	N	N	N	N	N	N	N	N	N	N	N	N
26	M	M	M	M	M	M	M	M	M	M	M	M
27	M	M	M	M	M	M	M	M	M	M	M	M
28	M	M	M	M	M	M	M	M	M	M	M	M
29	N	N	N	N	N	N	N	N	N	N	N	N
30	N	N	N	N	N	N	N	N	N	3	4	9
31	M	M	M	M	M	M	M	M	M	M	M	M

NOTE: FOR TYPE 1=FRONTAL, 2=SUBSIDENCE, 3=RADIATION (SPIKED ECHO)
4=RADIATION (LAMINAR ECHO) 9=UNKNOWN
N=NO INVERSION M=MISSING DATA OR UNKNOWN

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METECROLOGICAL STUCY MONTH OF OCTOBER 1976

******* FIRST INVERSION FREQUENCY OF OCCURENCE TABLE *******

THICKNESS (METERS)	SFC	INVERSION BASE HEIGHT (IN METERS) 100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	9	0	0	0	0	0	0	0	0	0	9
301-500	7	0	0	0	0	0	0	0	0	0	7
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											4
TOTAL	16	0	0	0	0	0	0	0	0	0	20
---TIME 601-1200 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	7	1	1	0	0	0	0	0	0	0	9
301-500	6	0	0	0	0	0	0	0	0	0	6
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											5
TOTAL	13	1	1	0	0	0	0	0	0	0	20
---TIME 1201-1800 MST											
001-100	0	0	1	0	0	0	0	0	0	0	1
101-300	0	1	0	0	0	0	0	0	0	0	1
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											18
TOTAL	0	1	1	0	0	0	0	0	0	0	20
---TIME 1801-2400 MST											
001-100	2	0	0	0	0	0	0	0	0	0	2
101-300	18	0	0	0	0	0	0	0	0	0	18
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											0
TOTAL	20	0	0	0	0	0	0	0	0	0	20
---------- FREQUENCY SUMMARY FOR FIRST INVERSION ----------											
001-100	2	0	1	0	0	0	0	0	0	0	3
101-300	34	2	1	0	0	0	0	0	0	0	37
301-500	13	0	0	0	0	0	0	0	0	0	13
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											27
TOTAL	49	2	2	0	0	0	0	0	0	0	80

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METECROLOGICAL STUDY MONTH OF OCTOBER 1976

******* SECOND INVERSION FREQUENCY OF OCCURENCE TABLE ******

THICKNESS (METERS)	INVERSION BASE HEIGHT (IN METERS) SFC	100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											20
TOTAL	0	0	0	0	0	0	0	0	0	0	20
---TIME 601-1200 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											20
TOTAL	0	0	0	0	0	0	0	0	0	0	20
---TIME 1201-1800 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											20
TOTAL	0	0	0	0	0	0	0	0	0	0	20
---TIME 1801-2400 MST											
001-100	0	0	0	1	1	0	0	0	0	0	2
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											18
TOTAL	0	0	0	1	1	0	0	0	0	0	20
---------- FREQUENCY SUMMARY FOR SECOND INVERSION ----------											
001-100	0	0	0	1	1	0	0	0	0	0	2
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											78
TOTAL	0	0	0	1	1	0	0	0	0	0	80

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF OCTOBER 1976

********* TWO HOUR STABILITY ANALYSIS **********

DAY	HOUR 02	04	06	08	10	12	14	16	18	20	22	24
1	M	M	M	M	M	M	M	M	M	M	M	M
2	M	M	M	M	M	M	M	M	M	M	M	M
3	M	M	M	M	M	M	M	M	M	M	M	M
4	M	M	M	M	M	M	M	M	M	M	M	M
5	M	M	M	M	M	M	M	M	M	M	M	M
6	M	M	M	M	M	M	M	M	M	M	M	M
7	F	F	F	F	F	B	D	C	C	D	F	F
8	F	F	F	F	F	F	D	C	C	F	F	F
9	F	E	E	E	E	E	D	C	C	E	E	E
10	E	E	E	F	D	D	D	D	D	D	E	E
11	F	E	E	E	D	C	C	C	C	E	E	E
12	E	F	F	F	D	C	C	C	D	E	E	E
13	E	E	E	E	D	D	C	C	E	E	E	E
14	F	F	D	D	D	C	C	C	C	E	E	E
15	E	E	E	E	D	C	C	B	B	F	E	E
16	F	E	E	E	E	D	C	C	E	E	E	E
17	D	D	D	D	C	C	C	C	C	E	F	F
18	F	F	F	F	F	D	C	C	D	F	F	F
19	F	F	F	F	D	C	C	C	D	D	F	F
20	F	F	F	F	D	C	C	C	D	F	F	F
21	F	F	F	E	E	D	C	C	D	D	E	E
22	M	M	M	M	M	M	M	M	M	M	M	M
23	D	D	E	E	D	C	C	C	D	F	E	E
24	F	F	F	F	E	D	C	C	E	E	E	E
25	D	D	D	D	D	C	C	C	D	D	E	E
26	M	M	M	M	M	M	M	M	M	M	M	M
27	M	M	M	M	M	M	M	M	M	M	M	M
28	M	M	M	M	M	M	M	M	M	M	M	M
29	D	D	D	D	D	C	C	C	D	D	F	F
30	F	F	F	F	E	E	E	E	D	E	E	E
31	M	M	M	M	M	M	M	M	M	M	M	M

PERCENT FREQUENCY OF OCCURENCE FOR EACH CATEGORY

A= 0.0 % B= 0.8 % C=13.2 % D=14.5 % E=19.1 % F=16.9 %

U= 0.0 % M=35.5 %

NOTE: U=UNKNOWN M=MISSING DATA
CLOUD COVER CONDITIONS USED FROM NWS STATION AT KALISPELL
WIND DATA USED FROM NWS STATION AT KALISPELL

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METECROLCGICAL STUDY MCNTH CF NOVEMEER 1976

FIRST INVERSION

DAY	0000-0600 MST BASE (100M)	TOP (100M)	TYPE *	0601-1200 MST BASE (100M)	TOP (100M)	TYPE *	1201-1800 MST BASE (100M)	TOP (100M)	TYPE *	1801-2400 MST BASE (100M)	TOP (100M)	TYPE *
1	0	2	3	0	2	3	N	N	N	0	2	4
2	0	3	4	0	4	3	2	3	4	0	2	4
3	0	2	4	0	3	4	2	2	4	0	1	4
4	0	2	4	0	1	4	5	6	2	4	5	2
5	5	6	2	5	6	2	4	5	2	3	4	2
6	0	2	3	0	2	3	8	9	2	7	8	2
7	1	2	4	0	1	4	6	7	2	0	1	4
8	0	1	4	0	1	4	2	3	2	0	1	4
9	0	2	4	0	4	4	3	4	4	1	2	4
10	1	2	3	1	2	3	3	4	2	0	3	4
11	0	4	4	0	4	4	2	3	4	0	2	4
12	0	1	4	0	1	4	3	4	2	3	4	2
13	5	5	2	6	7	2	4	5	2	0	1	4
14	0	1	4	0	1	4	0	1	4	2	3	2
15	2	3	4	1	2	4	1	4	4	0	1	4
16	0	2	4	0	2	4	2	3	4	0	2	4
17	0	2	3	0	2	3	N	N	N	0	2	3
18	0	1	3	0	1	3	N	N	N	0	2	4
19	0	1	4	0	1	4	N	N	N	0	1	4
20	0	2	4	0	2	4	N	N	N	0	2	4
21	0	3	4	0	3	4	N	N	N	N	N	N
22	N	N	N	0	1	4	N	N	N	0	2	4
23	0	4	4	0	3	4	2	3	4	0	1	4
24	0	3	4	0	3	4	0	2	4	N	N	N
25	0	1	3	0	1	3	N	N	N	0	1	4
26	0	1	3	0	1	3	N	N	N	0	2	4
27	M	M	M	M	M	M	M	M	M	M	M	M
28	M	M	M	M	M	M	M	M	M	M	M	M
29	M	M	M	M	M	M	M	M	M	M	M	M
30	N	N	N	0	2	4	N	N	N	0	3	4

SECOND INVERSION

DAY	0000-0600 MST BASE (100M)	TOP (100M)	TYPE *	0601-1200 MST BASE (100M)	TOP (100M)	TYPE *	1201-1800 MST BASE (100M)	TOP (100M)	TYPE *	1801-2400 MST BASE (100M)	TOP (100M)	TYPE *
1	N	N	N	N	N	N	N	N	N	N	N	N
2	N	N	N	N	N	N	N	N	N	N	N	N
3	N	N	N	N	N	N	N	N	N	N	N	N
4	6	7	2	6	7	2	N	N	N	N	N	N
5	N	N	N	N	N	N	N	N	N	N	N	N
6	3	4	2	7	8	2	N	N	N	N	N	N
7	6	8	2	6	7	2	N	N	N	2	4	2
8	2	3	2	2	3	2	N	N	N	3	4	2
9	N	N	N	N	N	N	N	N	N	7	8	2
10	7	8	2	6	7	2	N	N	N	3	4	2
11	N	N	N	N	N	N	N	N	N	3	5	2
12	2	3	3	3	4	2	N	N	N	N	N	N
13	N	N	N	N	N	N	N	N	N	3	4	2
14	3	3	4	3	4	2	4	5	2	4	5	2
15	N	N	N	N	N	N	N	N	N	N	N	N
16	N	N	N	N	N	N	N	N	N	N	N	N
17	N	N	N	N	N	N	N	N	N	N	N	N
18	N	N	N	N	N	N	N	N	N	N	N	N
19	N	N	N	N	N	N	N	N	N	N	N	N
20	N	N	N	N	N	N	N	N	N	N	N	N
21	N	N	N	N	N	N	N	N	N	N	N	N
22	N	N	N	N	N	N	N	N	N	3	4	2
23	N	N	N	N	N	N	N	N	N	2	3	4
24	N	N	N	N	N	N	N	N	N	N	N	N
25	N	N	N	N	N	N	N	N	N	N	N	N
26	N	N	N	N	N	N	N	N	N	N	N	N
27	M	M	M	M	M	M	M	M	M	M	M	M
28	M	M	M	M	M	M	M	M	M	M	M	M
29	M	M	M	M	M	M	M	M	M	M	M	M
30	N	N	N	N	N	N	N	N	N	N	N	N

NOTE: FOR TYPE 1=FRONTAL, 2=SUBSIDENCE, 3=RADIATION (SPIKED ECHO)
4=RADIATION (LAMINAR ECHO) 9=UNKNOWN
N=NO INVERSION M=MISSING DATA OR UNKNOWN

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF NOVEMBER 1976

******* FIRST INVERSION FREQUENCY OF OCCURENCE TABLE *******

THICKNESS (METERS)	SFC	INVERSION BASE HEIGHT (IN METERS) 100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	7	2	1	0	0	2	0	0	0	0	12
101-300	11	0	0	0	0	0	0	0	0	0	11
301-500	2	0	0	0	0	0	0	0	0	0	2
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											2
TOTAL	20	2	1	0	0	2	0	0	0	0	27
---TIME 601-1200 MST											
001-100	10	2	0	0	0	1	1	0	0	0	14
101-300	10	0	0	0	0	0	0	0	0	0	10
301-500	3	0	0	0	0	0	0	0	0	0	3
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											0
TOTAL	23	2	0	0	0	1	1	0	0	0	27
---TIME 1201-1800 MST											
001-100	1	0	6	3	2	1	1	0	1	0	15
101-300	1	1	0	0	0	0	0	0	0	0	2
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											10
TOTAL	2	1	6	3	2	1	1	0	1	0	27
---TIME 1801-2400 MST											
001-100	8	1	1	2	1	0	0	1	0	0	14
101-300	11	0	0	0	0	0	0	0	0	0	11
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											2
TOTAL	19	1	1	2	1	0	0	1	0	0	27
---------- FREQUENCY SUMMARY FOR FIRST INVERSION ----------											
001-100	26	5	8	5	3	4	2	1	1	0	55
101-300	33	1	0	0	0	0	0	0	0	0	34
301-500	5	0	0	0	0	0	0	0	0	0	5
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											14
TOTAL	64	6	8	5	3	4	2	1	1	0	108

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METECROLOGICAL STUDY MONTH OF NOVEMBER 1976

****** SECOND INVERSICN FREQUENCY OF OCCURENCE TABLE ******

THICKNESS (METERS)	INVERSICN BASE HEIGHT (IN METERS) SFC	100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	0	0	2	2	0	0	1	1	0	0	6
101-300	0	0	0	0	0	0	1	0	0	0	1
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											20
TOTAL	0	0	2	2	0	0	2	1	0	0	27
---TIME 601-1200 MST											
001-100	0	0	1	2	0	0	3	1	0	0	7
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											20
TOTAL	0	0	1	2	0	0	3	1	0	0	27
---TIME 1201-1800 MST											
001-100	0	0	0	0	1	0	0	0	0	0	1
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											26
TOTAL	0	0	0	0	1	0	0	0	0	0	27
---TIME 1801-2400 MST											
001-100	0	0	1	4	1	0	0	1	0	0	7
101-300	0	0	1	1	0	0	0	0	0	0	2
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											18
TOTAL	0	0	2	5	1	0	0	1	0	0	27
---------- FREQUENCY SUMMARY FOR SECOND INVERSION ----------											
001-100	0	0	4	8	2	0	4	3	0	0	21
101-300	0	0	1	1	0	0	1	0	0	0	3
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											84
TOTAL	0	0	5	9	2	0	5	3	0	0	108

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METECROLCGICAL STUDY MONTH CF NCVEMBER 1976

********* TWO HOUR STABILITY ANALYSIS **********

DAY	HOUR 02	04	06	08	10	12	14	16	18	20	22	24
1	E	E	E	E	E	D	C	C	C	F	F	F
2	F	F	F	E	E	E	C	D	B	E	E	E
3	E	F	F	E	E	E	B	D	B	F	E	E
4	E	E	E	D	C	B	C	B	D	D	D	D
5	C	D	D	D	B	E	B	B	D	C	C	D
6	D	D	E	E	E	E	D	D	D	D	D	D
7	E	E	E	E	E	D	C	C	D	E	E	E
8	E	E	E	E	E	E	C	C	D	F	M	M
9	E	E	E	E	F	F	C	C	D	E	E	E
10	E	E	E	E	E	E	C	C	C	F	F	F
11	F	F	F	E	E	E	C	E	D	F	F	F
12	F	E	E	E	E	D	C	D	D	D	C	D
13	D	D	D	D	E	E	C	C	D	F	E	E
14	E	E	E	E	E	E	E	E	D	D	E	E
15	D	D	D	D	E	E	E	C	E	E	E	E
16	E	E	E	E	E	E	D	D	D	D	E	E
17	E	E	E	E	E	E	E	D	D	D	E	E
18	F	E	E	E	E	E	D	C	D	E	E	E
19	E	E	E	E	F	D	C	C	D	E	F	F
20	F	F	F	F	F	F	D	B	D	F	F	F
21	F	F	F	E	E	D	B	B	D	D	C	E
22	D	D	E	E	E	D	B	C	D	F	E	E
23	F	F	F	E	E	E	E	E	E	E	E	E
24	F	E	E	E	E	D	E	E	E	D	D	D
25	E	E	E	D	D	D	D	D	E	E	E	E
26	E	E	E	E	D	C	C	C	D	F	F	F
27	M	M	M	M	M	M	M	M	M	M	M	M
28	M	M	M	M	M	M	M	M	M	M	M	M
29	M	M	M	M	M	M	M	M	M	M	M	M
30	D	D	E	E	E	E	C	D	E	E	E	E

PERCENT FREQUENCY OF OCCURENCE FOR EACH CATEGORY

A= 0.0 % B= 3.9 % C= 5.8 % D=24.4 % E=42.2 % F=13.1 %

U= 0.0 % M=10.6 %

NOTE: U=UNKNOWN M=MISSING DATA
CLOUD COVER CONDITIONS USED FROM NWS STATION AT KALISPELL
WIND DATA USED FROM NWS STATION AT KALISPELL

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY — MONTH OF JANUARY 1977

FIRST INVERSION

DAY	0000-0600 MST BASE (100M)	TOP (100M)	TYPE *	0601-1200 MST BASE (100M)	TOP (100M)	TYPE *	1201-1800 MST BASE (100M)	TOP (100M)	TYPE *	1801-2400 MST BASE (100M)	TOP (100M)	TYPE *
1	0	2	4	0	2	4	N	N	N	0	1	4
2	0	2	3	0	2	3	N	N	N	N	N	N
3	N	N	N	1	2	3	N	N	N	0	1	4
4	0	2	3	N	N	N	N	N	N	0	2	3
5	0	2	4	0	2	4	0	3	3	0	1	4
6	N	N	N	N	N	N	N	N	N	0	2	4
7	0	3	4	0	2	4	N	N	N	0	2	3
8	0	2	4	0	2	3	N	N	N	0	3	4
9	M	M	M	2	3	9	2	3	9	0	1	4
10	M	M	M	2	3	9	2	2	9	0	1	4
11	M	M	M	0	1	4	4	5	9	4	4	9
12	N	N	N	0	2	3	1	2	4	1	2	4
13	0	2	4	0	2	4	0	1	4	0	1	4
14	0	1	4	0	1	4	N	N	N	N	N	N
15	N	N	N	N	N	N	N	N	N	N	N	N
16	N	N	N	0	1	4	0	1	4	2	3	9
17	M	M	M	2	3	9	2	3	9	1	2	9
18	1	2	9	0	2	4	N	N	N	0	2	4
19	0	1	4	0	2	4	0	2	4	3	4	9
20	4	5	9	4	5	9	4	5	9	5	6	9
21	N	N	N	N	N	N	4	5	9	4	5	9
22	N	N	N	0	1	3	N	N	N	N	N	N
23	0	1	3	N	N	N	N	N	N	N	N	N
24	0	1	4	N	N	N	N	N	N	M	M	M
25	M	M	M	M	M	M	M	M	M	M	M	M
26	M	M	M	M	M	M	N	N	N	N	N	N
27	0	2	4	0	3	4	N	N	N	0	1	3
28	M	M	M	N	M	M	M	M	M	M	M	M
29	M	M	M	M	M	M	M	M	M	M	M	M
30	M	M	M	M	M	M	M	M	M	M	M	M
31	M	M	M	M	M	M	M	M	M	M	M	M

SECOND INVERSION

DAY	0000-0600 MST BASE (100M)	TOP (100M)	TYPE *	0601-1200 MST BASE (100M)	TOP (100M)	TYPE *	1201-1800 MST BASE (100M)	TOP (100M)	TYPE *	1801-2400 MST BASE (100M)	TOP (100M)	TYPE *
1	N	N	N	N	N	N	N	N	N	N	N	N
2	N	N	N	N	N	N	N	N	N	N	N	N
3	N	N	N	N	N	N	N	N	N	N	N	N
4	N	N	N	N	N	N	N	N	N	N	N	N
5	N	N	N	N	N	N	N	N	N	N	N	N
6	N	N	N	N	N	N	N	N	N	N	N	N
7	N	N	N	N	N	N	N	N	N	N	N	N
8	N	N	N	N	N	N	N	N	N	N	N	N
9	M	M	M	N	N	N	N	N	N	3	4	9
10	M	M	M	N	N	N	N	N	N	2	3	9
11	M	M	M	2	3	9	N	N	N	N	N	N
12	M	M	M	N	N	N	N	N	N	N	N	N
13	N	N	N	N	N	N	N	N	N	N	N	N
14	N	N	N	N	N	N	N	N	N	N	N	N
15	N	N	N	N	N	N	N	N	N	N	N	N
16	N	N	N	3	5	9	3	4	9	N	N	N
17	M	M	M	N	N	N	N	N	N	N	N	N
18	N	N	N	N	N	N	N	N	N	N	N	N
19	N	N	N	4	5	9	4	5	9	N	N	N
20	N	N	N	N	N	N	N	N	N	N	N	N
21	N	N	N	N	N	N	N	N	N	N	N	N
22	N	N	N	N	N	N	N	N	N	N	N	N
23	N	N	N	N	N	N	N	N	N	N	N	N
24	N	N	N	N	N	N	N	N	N	M	M	M
25	M	M	M	M	M	M	M	M	M	M	M	M
26	M	M	M	M	M	M	N	N	N	N	N	N
27	N	N	N	N	N	N	N	N	N	N	N	N
28	M	M	M	M	M	M	M	M	M	M	M	M
29	M	M	M	M	M	M	M	M	M	M	M	M
30	M	M	M	M	M	M	M	M	M	M	M	M
31	M	M	M	M	M	M	M	M	M	M	M	M

NOTE: FOR TYPE 1=FRONTAL, 2=SUBSIDENCE, 3=RADIATION (SPIKED ECHO)
4=RADIATION (LAMINAR ECHO) 9=UNKNOWN
N=NO INVERSION M=MISSING DATA OR UNKNOWN

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METECROLCGICAL STUDY MCNTH OF JANUARY 1977

******* FIRST INVERSICN FREQUENCY OF CCCURENCE TABLE *******

THICKNESS (METERS)	SFC	INVERSION BASE HEIGHT (IN METERS) 100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	4	1	0	0	1	0	0	0	0	0	6
101-300	8	0	0	0	0	0	0	0	0	0	8
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											6
TOTAL	12	1	0	0	1	0	0	0	0	0	20
---TIME 601-1200 MST											
001-100	4	1	3	0	1	0	0	0	0	0	9
101-300	10	0	0	0	0	0	0	0	0	0	10
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											6
TOTAL	14	1	3	0	1	0	0	0	0	0	25
---TIME 1201-1800 MST											
001-100	2	1	3	0	3	0	0	0	0	0	9
101-300	2	0	0	0	0	0	0	0	0	0	2
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											15
TOTAL	4	1	3	0	3	0	0	0	0	0	26
---TIME 1801-2400 MST											
001-100	7	2	1	1	2	1	0	0	0	0	14
101-300	5	0	0	0	0	0	0	0	0	0	5
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											6
TOTAL	12	2	1	1	2	1	0	0	0	0	25
---------- FREQUENCY SUMMARY FOR FIRST INVERSION ----------											
001-100	17	5	7	1	7	1	0	0	0	0	38
101-300	25	0	0	0	0	0	0	0	0	0	25
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											33
TOTAL	42	5	7	1	7	1	0	0	0	0	96

ACOUSTIC RADAR ANALYSIS

OLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF JANUARY 1977

****** SECOND INVERSION FREQUENCY OF OCCURENCE TABLE ******

HICKNESS (METERS)	SFC	INVERSION BASE HEIGHT (IN METERS) 100	200	300	400	500	600	700	800	900	TOTAL
--TIME)- 600 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
0 INVERSION											20
TOTAL	0	0	0	0	0	0	0	0	0	0	20
--TIME 601-1200 MST											
001-100	0	0	1	0	1	0	0	0	0	0	2
101-300	0	0	0	1	0	0	0	0	0	0	1
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
0 INVERSION											22
TOTAL	0	0	1	1	1	0	0	0	0	0	25
--TIME 1201-1800 MST											
001-100	0	0	0	1	1	0	0	0	0	0	2
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
0 INVERSION											24
TOTAL	0	0	0	1	1	0	0	0	0	0	26
--TIME 1801-2400 MST											
001-100	0	0	1	1	0	0	0	0	0	0	2
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
C INVERSION											23
TOTAL	0	0	1	1	0	0	0	0	0	0	25
---------- FREQUENCY SUMMARY FOR SECOND INVERSION ----------											
001-100	0	0	2	2	2	0	0	0	0	0	6
101-300	0	0	0	1	0	0	0	0	0	0	1
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
0 INVERSION											89
TOTAL	0	0	2	3	2	0	0	0	0	0	96

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METECROLOGICAL STUDY MCNTH OF JANUARY 1977

********* TWC HCUR STABILITY ANALYSIS **********

	HOUR											
DAY	02	04	06	08	10	12	14	16	18	20	22	24
1	E	F	F	E	E	D	C	B	D	F	F	F
2	F	F	F	F	E	D	C	C	D	D	D	D
3	D	D	E	D	D	B	C	C	D	D	E	E
4	E	E	E	E	E	D	C	C	E	E	E	E
5	E	F	F	E	E	E	E	C	D	D	E	E
6	D	D	D	D	B	B	C	B	F	E	E	E
7	E	E	E	E	E	E	D	C	E	E	E	E
8	E	E	E	D	D	C	C	C	D	F	E	E
9	M	M	M	M	D	B	B	B	E	D	E	E
10	M	M	M	M	D	D	D	C	C	D	E	E
11	M	M	M	M	E	E	E	B	B	D	D	D
12	M	M	M	M	E	E	E	E	E	E	E	E
13	E	E	E	E	E	E	E	E	E	E	E	E
14	E	E	E	E	E	E	D	D	D	D	D	D
15	D	D	D	D	D	D	D	D	D	D	D	D
16	D	D	D	E	E	E	E	D	D	D	D	D
17	M	M	M	M	D	D	D	D	D	D	D	D
18	D	D	E	E	E	E	M	M	M	M	M	M
19	M	M	M	M	M	M	M	D	D	D	D	D
20	D	D	D	D	D	D	D	D	D	D	D	D
21	D	D	D	D	D	D	D	D	D	D	D	D
22	D	E	E	E	D	D	D	D	D	D	D	D
23	E	E	E	D	D	D	D	D	D	D	D	D
24	E	E	E	D	D	D	D	D	M	M	M	M
25	M	M	M	M	M	M	M	M	M	M	M	M
26	M	M	M	M	M	M	D	D	D	D	D	D
27	D	F	F	F	F	D	B	B	E	E	F	F
28	M	M	M	M	M	M	M	M	M	M	M	M
29	M	M	M	M	M	M	M	M	M	M	M	M
30	M	M	M	M	M	M	M	M	M	M	M	M
31	M	M	M	M	M	M	M	M	M	M	M	M

PERCENT FREQUENCY OF OCCURENCE FOR EACH CATEGORY

A= 0.0 % B= 3.5 % C= 3.8 % D=34.9 % E=25.0 % F= 5.1 %

U= 0.0 % M=27.7 %

NOTE: U=UNKNOWN M=MISSING DATA
CLOUD COVER CONDITIONS USED FROM NWS STATION AT KALISPELL
WIND DATA USED FROM NWS STATION AT KALISPELL

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF February 1977

FIRST INVERSION

DAY	0000-0600 MST BASE (100M)	TOP (100M)	TYPE *	0601-1200 MST BASE (100M)	TOP (100M)	TYPE *	1201-1800 MST BASE (100M)	TOP (100M)	TYPE *	1801-2400 MST BASE (100M)	TOP (100M)	TYPE *
1	0	3	3	0	3	3	N	N	N	0	1	3
2	0	3	3	0	1	3	4	5	2	4	5	2
3	4	5	2	N	N	N	N	N	N	0	2	4
4	0	3	4	0	3	4	N	N	N	0	2	4
5	0	3	4	0	3	4	0	2	4	0	2	4
6	0	2	4	0	3	4	N	N	N	0	2	4
7	0	3	4	0	3	4	N	N	N	0	N	N
8	0	3	4	0	3	4	0	1	3	0	1	3
9	0	3	4	0	3	4	N	N	N	0	2	4
10	0	4	4	0	3	4	N	N	N	N	N	N
11	0	4	4	0	3	4	N	N	N	0	1	4
12	0	4	4	0	2	4	0	2	4	0	2	4
13	0	4	4	0	3	4	0	2	3	0	1	4
14	0	4	4	0	3	4	1	2	3	0	2	4
15	0	4	4	0	3	4	0	2	3	0	3	4
16	0	3	3	0	3	4	2	3	3	0	3	4
17	0	4	4	0	4	4	2	3	3	0	3	4
18	0	3	4	N	N	N	N	N	N	0	1	4
19	0	3	4	0	3	4	N	N	N	0	2	4
20	0	3	4	0	3	4	2	3	3	0	1	4
21	0	3	4	0	2	4	0	2	4	0	2	4
22	0	1	4	0	1	4	M	M	M	M	M	M
23	M	M	M	M	M	M	M	M	M	M	M	M
24	M	M	M	M	M	M	M	M	M	M	M	M
25	M	M	M	M	M	M	M	M	M	M	M	M
26	M	M	M	M	M	M	M	M	M	M	M	M
27	M	M	M	M	M	M	M	M	M	M	M	M
28	M	M	M	M	M	M	M	M	M	M	M	M

SECOND INVERSION

DAY	0000-0600 MST BASE (100M)	TOP (100M)	TYPE *	0601-1200 MST BASE (100M)	TOP (100M)	TYPE *	1201-1800 MST BASE (100M)	TOP (100M)	TYPE *	1801-2400 MST BASE (100M)	TOP (100M)	TYPE *
1	N	N	N	N	N	N	N	N	N	N	N	N
2	N	N	N	N	N	N	N	N	N	N	N	N
3	N	N	N	N	N	N	N	N	N	N	N	N
4	N	N	N	N	N	N	N	N	N	N	N	N
5	N	N	N	N	N	N	N	N	N	N	N	N
6	N	N	N	N	N	N	N	N	N	N	N	N
7	N	N	N	N	N	N	N	N	N	N	N	N
8	N	N	N	N	N	N	N	N	N	N	N	N
9	N	N	N	N	N	N	N	N	N	N	N	N
10	N	N	N	N	N	N	N	N	N	N	N	N
11	N	N	N	N	N	N	N	N	N	N	N	N
12	N	N	N	4	5	9	4	5	9	4	5	9
13	N	N	N	N	N	N	N	N	N	N	N	N
14	N	N	N	N	N	N	N	N	N	N	N	N
15	N	N	N	N	N	N	N	N	N	N	N	N
16	N	N	N	N	N	N	N	N	N	4	5	9
17	N	N	N	N	N	N	N	N	N	N	N	N
18	N	N	N	N	N	N	N	N	N	N	N	N
19	N	N	N	N	N	N	N	N	N	N	N	N
20	N	N	N	N	N	N	N	N	N	3	4	9
21	N	N	N	N	N	N	N	N	N	N	N	N
22	N	N	N	N	N	N	M	M	M	M	M	M
23	M	M	M	M	M	M	M	M	M	M	M	M
24	M	M	M	M	M	M	M	M	M	M	M	M
25	M	M	M	M	M	M	M	M	M	M	M	M
26	M	M	M	M	M	M	M	M	M	M	M	M
27	M	M	M	M	M	M	M	M	M	M	M	M
28	M	M	M	M	M	M	M	M	M	M	M	M

NOTE: FOR TYPE 1=FRONTAL, 2=SUBSIDENCE, 3=RADIATION (SPIKED ECHO)
4=RADIATION (LAMINAR ECHO) 9=UNKNOWN
N=NO INVERSION M=MISSING DATA OR UNKNOWN

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF February 1977

******* FIRST INVERSION FREQUENCY OF OCCURENCE TABLE *******

THICKNESS (METERS)	SFC	INVERSION BASE HEIGHT (IN METERS) 100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	2	0	2	0	1	0	0	0	0	0	5
101-300	16	0	0	0	0	0	0	0	0	0	16
301-500	1	0	0	0	0	0	0	0	0	0	1
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											0
TOTAL	19	0	2	0	1	0	0	0	0	0	22
---TIME 601-1200 MST											
001-100	3	0	1	0	0	0	0	0	0	0	4
101-300	15	0	0	0	0	0	0	0	0	0	15
301-500	1	0	0	0	0	0	0	0	0	0	1
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											2
TOTAL	19	0	1	0	0	0	0	0	0	0	22
---TIME 1201-1800 MST											
001-100	1	2	2	0	1	0	0	0	0	0	6
101-300	5	0	0	0	0	0	0	0	0	0	5
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											10
TOTAL	6	2	2	0	1	0	0	0	0	0	21
---TIME 1801-2400 MST											
001-100	6	0	0	0	1	0	0	0	0	0	7
101-300	12	0	0	0	0	0	0	0	0	0	12
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											2
TOTAL	18	0	0	0	1	0	0	0	0	0	21
---------- FREQUENCY SUMMARY FOR FIRST INVERSION ----------											
001-100	12	2	5	0	3	0	0	0	0	0	22
101-300	48	0	0	0	0	0	0	0	0	0	48
301-500	2	0	0	0	0	0	0	0	0	0	2
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											14
TOTAL	62	2	5	0	3	0	0	0	0	0	86

ACOUSTIC DATA ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF February 1977

******* SECOND INVERSION FREQUENCY OF OCCURENCE TABLE ******

THICKNESS (METERS)	SFC	INVERSION BASE HEIGHT (IN METERS) 100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											22
TOTAL	0	0	0	0	0	0	0	0	0	0	22
---TIME 601-1200 MST											
001-100	0	0	0	0	1	0	0	0	0	0	1
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											21
TOTAL	0	0	0	0	1	0	0	0	0	0	22
---TIME 1201-1800 MST											
001-100	0	0	0	0	1	0	0	0	0	0	1
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											20
TOTAL	0	0	0	0	1	0	0	0	0	0	21
---TIME 1801-2400 MST											
001-100	0	0	0	1	2	0	0	0	0	0	3
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											18
TOTAL	0	0	0	1	2	0	0	0	0	0	21
---------- FREQUENCY SUMMARY FOR SECOND INVERSION ----------											
001-100	0	0	0	1	4	0	0	0	0	0	5
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											81
TOTAL	0	0	0	1	4	0	0	0	0	0	86

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF February 1977

********** TWO HOUR STABILITY ANALYSIS **********

DAY	HOUR 02	04	06	08	10	12	14	16	18	20	22	24
1	E	E	E	E	E	E	D	D	D	D	E	E
2	E	E	E	E	C	C	C	C	C	C	C	D
3	D	D	D	D	D	D	C	E	D	E	E	E
4	E	F	F	E	E	D	C	C	E	E	E	F
5	E	E	E	E	E	E	C	E	D	D	D	E
6	E	E	E	F	C	D	C	C	E	F	E	E
7	E	E	E	E	D	D	C	C	C	C	C	E
8	E	E	E	E	E	E	E	E	E	E	E	E
9	E	E	E	E	D	D	D	C	F	F	F	F
10	E	E	E	E	C	C	C	C	D	D	D	D
11	D	E	E	E	E	E	D	C	C	C	F	F
12	F	F	F	F	D	C	C	D	D	E	F	F
13	F	F	F	E	E	E	E	E	E	F	E	E
14	F	F	F	E	E	E	D	D	D	F	E	E
15	E	E	E	E	E	F	E	E	F	E	E	E
16	E	E	E	E	E	F	E	D	D	F	F	F
17	E	E	E	F	F	F	E	E	F	F	F	F
18	F	E	E	F	D	D	D	D	E	E	F	F
19	F	F	F	F	E	D	C	B	D	F	F	F
20	F	F	F	F	E	D	B	B	D	D	E	E
21	E	E	E	E	E	E	E	E	E	E	E	E
22	E	E	E	F	E	E	M	M	M	M	M	M
23	M	M	M	M	M	M	M	M	M	M	M	M
24	M	M	M	M	M	M	M	M	M	M	M	M
25	M	M	M	M	M	M	M	M	M	M	M	M
26	M	M	M	M	M	M	M	M	M	M	M	M
27	M	M	M	M	M	M	M	M	M	M	M	M
28	M	M	M	M	M	M	M	M	M	M	M	M

PERCENT FREQUENCY OF OCCURENCE FOR EACH CATEGORY

A= 0.0 % B= 2.1 % C= 3.3 % D=19.0 % E=38.4 % F=14.0 %

U= 0.0 % M=23.2 %

NOTE: U=UNKNOWN M=MISSING DATA
CLOUD COVER CONDITIONS USED FROM NWS STATION AT KALISPELL
WIND DATA USED FROM NWS STATION AT KALISPELL

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF MARCH 1977

FIRST INVERSION

DAY	0000-0600 MST BASE (100M)	TOP (100M)	TYPE *	0601-1200 MST BASE (100M)	TOP (100M)	TYPE *	1201-1800 MST BASE (100M)	TOP (100M)	TYPE *	1801-2400 MST BASE (100M)	TOP (100M)	TYPE *
1	M	M	M	M	M	M	M	M	M	M	M	M
2	M	M	M	M	M	M	M	M	M	M	M	M
3	M	M	M	M	M	M	M	M	M	M	M	M
4	M	M	M	M	M	M	M	M	M	M	M	M
5	M	M	M	M	M	M	M	M	M	M	M	M
6	M	M	M	M	M	M	M	M	M	M	M	M
7	M	M	M	M	M	M	M	M	M	M	M	M
8	M	M	M	M	M	M	M	M	M	M	M	M
9	M	M	M	M	M	M	M	M	M	M	M	M
10	M	M	M	M	M	M	M	M	M	M	M	M
11	M	M	M	M	M	M	M	M	M	M	M	M
12	M	M	M	M	M	M	M	M	M	M	M	M
13	M	M	M	M	M	M	M	M	M	M	M	M
14	M	M	M	M	M	M	M	M	M	M	M	M
15	M	M	M	M	M	M	N	N	N	0	3	4
16	0	4	4	0	5	4	N	N	N	0	2	4
17	0	2	4	0	2	3	N	N	N	0	2	3
18	0	2	4	0	3	4	N	N	N	0	2	3
19	N	N	N	N	N	N	N	N	N	0	2	4
20	0	3	4	0	3	4	N	N	N	0	1	3
21	0	2	3	2	3	9	N	N	N	0	3	3
22	0	3	4	0	3	4	N	N	N	0	3	4
23	0	4	4	0	3	4	1	2	9	N	N	N
24	0	3	3	0	2	3	N	N	N	0	2	4
25	0	3	4	0	2	4	N	N	N	0	2	3
26	0	1	3	N	N	N	N	N	N	0	2	3
27	0	2	3	N	N	N	N	N	N	0	2	4
28	N	N	N	N	N	N	N	N	N	0	2	4
29	0	1	3	N	N	N	N	N	N	0	1	3
30	0	2	4	N	N	N	N	N	N	0	2	3
31	0	2	3	N	N	N	N	N	N	2	3	9

SECOND INVERSION

DAY	0000-0600 MST BASE (100M)	TOP (100M)	TYPE *	0601-1200 MST BASE (100M)	TOP (100M)	TYPE *	1201-1800 MST BASE (100M)	TOP (100M)	TYPE *	1801-2400 MST BASE (100M)	TOP (100M)	TYPE *
1	M	M	M	M	M	M	M	M	M	M	M	M
2	M	M	M	M	M	M	M	M	M	M	M	M
3	M	M	M	M	M	M	M	M	M	M	M	M
4	M	M	M	M	M	M	M	M	M	M	M	M
5	M	M	M	M	M	M	M	M	M	M	M	M
6	M	M	M	M	M	M	M	M	M	M	M	M
7	M	M	M	M	M	M	M	M	M	M	M	M
8	M	M	M	M	M	M	M	M	M	M	M	M
9	M	M	M	M	M	M	M	M	M	M	M	M
10	M	M	M	M	M	M	M	M	M	M	M	M
11	M	M	M	M	M	M	M	M	M	M	M	M
12	M	M	M	M	M	M	M	M	M	M	M	M
13	M	M	M	M	M	M	M	M	M	M	M	M
14	M	M	M	M	M	M	M	M	M	M	M	M
15	M	M	M	M	M	M	N	N	N	N	N	N
16	N	N	N	N	N	N	N	N	N	N	N	N
17	N	N	N	N	N	N	N	N	N	N	N	N
18	N	N	N	N	N	N	N	N	N	N	N	N
19	N	N	N	N	N	N	N	N	N	N	N	N
20	N	N	N	N	N	N	N	N	N	N	N	N
21	N	N	N	N	N	N	N	N	N	N	N	N
22	N	N	N	N	N	N	N	N	N	N	N	N
23	N	N	N	N	N	N	N	N	N	N	N	N
24	N	N	N	N	N	N	N	N	N	N	N	N
25	N	N	N	N	N	N	N	N	N	N	N	N
26	N	N	N	N	N	N	N	N	N	N	N	N
27	N	N	N	N	N	N	N	N	N	N	N	N
28	N	N	N	N	N	N	N	N	N	N	N	N
29	N	N	N	N	N	N	N	N	N	N	N	N
30	N	N	N	N	N	N	N	N	N	N	N	N
31	N	N	N	N	N	N	N	N	N	N	N	N

NOTE: FOR TYPE 1=FRONTAL, 2=SUBSIDENCE, 3=RADIATION (SPIKED ECHO)
4=RADIATION (LAMINAR ECHO) 9=UNKNOWN
N=NO INVERSION M=MISSING DATA OR UNKNOWN

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF MARCH 1977

******* FIRST INVERSION FREQUENCY OF OCCURENCE TABLE *******

THICKNESS (METERS)	INVERSION BASE HEIGHT (IN METERS) SFC	100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	2	0	0	0	0	0	0	0	0	0	2
101-300	10	0	0	0	0	0	0	0	0	0	10
301-500	2	0	0	0	0	0	0	0	0	0	2
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											2
TOTAL	14	0	0	0	0	0	0	0	0	0	16
---TIME 601-1200 MST											
001-100	0	0	1	0	0	0	0	0	0	0	1
101-300	7	0	0	0	0	0	0	0	0	0	7
301-500	1	0	0	0	0	0	0	0	0	0	1
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											7
TOTAL	8	0	1	0	0	0	0	0	0	0	16
---TIME 1201-1800 MST											
001-100	0	1	0	0	0	0	0	0	0	0	1
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											16
TOTAL	0	1	0	0	0	0	0	0	0	0	17
---TIME 1801-2400 MST											
001-100	2	0	1	0	0	0	0	0	0	0	3
101-300	13	0	0	0	0	0	0	0	0	0	13
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											1
TOTAL	15	0	1	0	0	0	0	0	0	0	17
---------- FREQUENCY SUMMARY FOR FIRST INVERSION ----------											
001-100	4	1	2	0	0	0	0	0	0	0	7
101-300	30	0	0	0	0	0	0	0	0	0	30
301-500	3	0	0	0	0	0	0	0	0	0	3
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											26
TOTAL	37	1	2	0	0	0	0	0	0	0	66

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF MARCH 1977

****** SECOND INVERSION FREQUENCY OF OCCURENCE TABLE ******

THICKNESS (METERS)	SFC	INVERSION BASE HEIGHT (IN METERS) 100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											16
TOTAL	0	0	0	0	0	0	0	0	0	0	16
---TIME 601-1200 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											16
TOTAL	0	0	0	0	0	0	0	0	0	0	16
---TIME 1201-1800 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											17
TOTAL	0	0	0	0	0	0	0	0	0	0	17
---TIME 1801-2400 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											17
TOTAL	0	0	0	0	0	0	0	0	0	0	17
---------- FREQUENCY SUMMARY FOR SECOND INVERSION ----------											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											66
TOTAL	0	0	0	0	0	0	0	0	0	0	66

ACCUSTIC RADAR ANALYSIS

COLUMBIA FALLS METECROLOGICAL STUDY MONTH OF MARCH 1977

********* TWO HOUR STABILITY ANALYSIS **********

DAY	HOUR 02	04	06	08	10	12	14	16	18	20	22	24
1	M	M	M	M	M	M	M	M	M	M	M	M
2	M	M	M	M	M	M	M	M	M	M	M	M
3	M	M	M	M	M	M	M	M	M	M	M	M
4	M	M	M	M	M	M	M	M	M	M	M	M
5	M	M	M	M	M	M	M	M	M	M	M	M
6	M	M	M	M	M	M	M	M	M	M	M	M
7	M	M	M	M	M	M	M	M	M	M	M	M
8	M	M	M	M	M	M	M	M	M	M	M	M
9	M	M	M	M	M	M	M	M	M	M	M	M
10	M	M	M	M	M	M	M	M	M	M	M	M
11	M	M	M	M	M	M	M	M	M	M	M	M
12	M	M	M	M	M	M	M	M	M	M	M	M
13	M	M	M	M	M	M	M	M	M	M	M	M
14	M	M	M	M	M	M	M	M	M	M	M	M
15	M	M	M	M	M	M	M	C	C	D	E	E
16	F	E	E	E	D	C	C	C	C	D	E	E
17	M	M	M	D	D	D	M	M	D	D	M	M
18	M	M	M	E	D	C	E	D	C	E	E	E
19	D	D	D	D	D	D	D	D	D	F	E	E
20	F	E	D	E	E	D	D	C	C	M	M	M
21	M	M	D	D	D	M	M	M	M	M	M	M
22	F	F	F	E	D	C	C	C	C	E	F	F
23	F	E	E	E	E	D	D	D	D	D	D	D
24	E	E	E	E	D	C	C	D	D	F	F	F
25	F	E	E	E	F	B	C	C	D	F	E	E
26	E	D	D	D	C	C	C	C	D	D	E	D
27	D	E	E	D	C	C	C	C	D	E	E	E
28	D	D	D	D	C	C	C	C	C	E	E	E
29	E	E	E	D	C	C	M	M	M	M	M	M
30	M	M	M	D	M	M	M	M	D	E	E	E
31	E	E	E	D	C	C	D	D	D	D	D	D

PERCENT FREQUENCY OF OCCURENCE FOR EACH CATEGORY

A= 0.0 % B= 0.5 % C= 9.4 % D=16.1 % E=13.4 % F= 4.0 %

U= 0.0 % M=56.5 %

NOTE: U=UNKNOWN M=MISSING DATA
CLOUD COVER CONDITIONS USED FROM NWS STATION AT KALISPELL
WIND DATA USED FROM NWS STATION AT KALISPELL

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY — MONTH OF APRIL 1977

FIRST INVERSION

DAY	0000-0600 MST BASE (100M)	TOP (100M)	TYPE *	0601-1200 MST BASE (100M)	TOP (100M)	TYPE *	1201-1800 MST BASE (100M)	TOP (100M)	TYPE *	1801-2400 MST BASE (100M)	TOP (100M)	TYPE *
1	0	2	4	0	2	4	N	N	N	0	1	3
2	0	2	4	2	3	3	N	N	N	0	2	3
3	0	2	4	1	2	3	N	N	N	0	3	4
4	0	3	4	0	4	4	N	N	N	0	2	4
5	0	4	4	0	4	4	N	N	N	0	2	4
6	0	4	4	2	4	4	N	N	N	0	2	4
7	0	3	4	2	4	4	N	N	N	0	2	4
8	0	4	4	0	4	4	N	N	N	N	N	N
9	0	2	3	N	N	N	N	N	N	0	1	4
10	0	3	4	N	N	N	N	N	N	0	1	3
11	0	3	4	N	N	N	N	N	N	0	2	4
12	0	4	4	N	N	N	N	N	N	0	1	4
13	0	3	4	0	3	4	N	N	N	0	1	3
14	0	1	4	N	N	N	N	N	N	0	2	4
15	0	2	4	2	3	3	N	N	N	N	N	N
16	0	2	4	0	3	4	N	N	N	0	1	3
17	0	2	4	N	N	N	N	N	N	0	1	4
18	0	2	4	N	N	N	N	N	N	0	1	4
19	0	2	4	N	N	N	N	N	N	N	N	N
20	N	N	N	M	M	M	N	N	N	0	2	4
21	0	3	4	N	N	N	N	N	N	0	2	4
22	0	1	4	0	4	4	N	N	N	0	3	4
23	0	4	4	3	4	4	N	N	N	0	2	3
24	0	3	4	N	N	N	N	N	N	0	1	4
25	0	2	4	N	N	N	N	N	N	0	2	4
26	0	3	4	N	N	N	N	N	N	0	1	4
27	0	2	4	M	M	M	M	M	M	M	M	M
28	M	M	M	M	M	M	N	N	N	0	1	4
29	0	3	4	N	N	N	N	N	N	0	1	4
30	0	4	4	0	3	4	N	N	N	0	2	3

SECOND INVERSION

DAY	0000-0600 MST BASE (100M)	TOP (100M)	TYPE *	0601-1200 MST BASE (100M)	TOP (100M)	TYPE *	1201-1800 MST BASE (100M)	TOP (100M)	TYPE *	1801-2400 MST BASE (100M)	TOP (100M)	TYPE *
1	N	N	N	N	N	N	N	N	N	N	N	N
2	N	N	N	N	N	N	N	N	N	N	N	N
3	N	N	N	3	4	4	N	N	N	N	N	N
4	N	N	N	N	N	N	N	N	N	N	N	N
5	N	N	N	N	N	N	N	N	N	N	N	N
6	N	N	N	N	N	N	N	N	N	N	N	N
7	N	N	N	N	N	N	N	N	N	N	N	N
8	N	N	N	N	N	N	N	N	N	N	N	N
9	N	N	N	N	N	N	N	N	N	N	N	N
10	N	N	N	N	N	N	N	N	N	N	N	N
11	N	N	N	N	N	N	N	N	N	N	N	N
12	N	N	N	N	N	N	N	N	N	N	N	N
13	N	N	N	N	N	N	N	N	N	N	N	N
14	N	N	N	N	N	N	N	N	N	N	N	N
15	N	N	N	N	N	N	N	N	N	N	N	N
16	N	N	N	N	N	N	N	N	N	N	N	N
17	N	N	N	N	N	N	N	N	N	N	N	N
18	N	N	N	N	N	N	N	N	N	N	N	N
19	N	N	N	N	N	N	N	N	N	N	N	N
20	N	N	N	M	M	M	N	N	N	N	N	N
21	N	N	N	N	N	N	N	N	N	N	N	N
22	3	4	5	N	N	N	N	N	N	N	N	N
23	N	N	N	N	N	N	N	N	N	N	N	N
24	N	N	N	N	N	N	N	N	N	N	N	N
25	N	N	N	N	N	N	N	N	N	N	N	N
26	N	N	N	N	N	N	M	M	M	N	N	N
27	N	N	N	M	M	M	M	M	M	M	M	M
28	M	M	M	M	M	M	N	N	N	N	N	N
29	N	N	N	N	N	N	N	N	N	N	N	N
30	N	N	N	N	N	N	N	N	N	N	N	N

NOTE: FOR TYPE 1=FRONTAL, 2=SUBSIDENCE, 3=RADIATION (SPIKED ECHO)
4=RADIATION (LAMINAR ECHO) 5=UNKNOWN
N=NO INVERSION M=MISSING DATA OR UNKNOWN

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METECROLOGICAL STUDY MONTH OF APRIL 1977

******* FIRST INVERSION FREQUENCY OF OCCURRENCE TABLE *******

THICKNESS (METERS)	INVERSION BASE HEIGHT (IN METERS) SFC	100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	2	0	0	0	0	0	0	0	0	0	2
101-300	20	0	0	0	0	0	0	0	0	0	20
301-500	6	0	0	0	0	0	0	0	0	0	6
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											1
TOTAL	28	0	0	0	0	0	0	0	0	0	29
---TIME 601-1200 MST											
001-100	0	1	2	1	0	0	0	0	0	0	4
101-300	4	0	2	0	0	0	0	0	0	0	6
301-500	4	0	0	0	0	0	0	0	0	0	4
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											13
TOTAL	8	1	4	1	0	0	0	0	0	0	27
---TIME 1201-1800 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											29
TOTAL	0	0	0	0	0	0	0	0	0	0	29
---TIME 1801-2400 MST											
001-100	12	0	0	0	0	0	0	0	0	0	12
101-300	14	0	0	0	0	0	0	0	0	0	14
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											3
TOTAL	26	0	0	0	0	0	0	0	0	0	29
---------- FREQUENCY SUMMARY FOR FIRST INVERSION ----------											
001-100	14	1	2	1	0	0	0	0	0	0	18
101-300	38	0	2	0	0	0	0	0	0	0	40
301-500	10	0	0	0	0	0	0	0	0	0	10
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											46
TOTAL	62	1	4	1	0	0	0	0	0	0	114

ACCUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF APRIL 1977

****** SECOND INVERSION FREQUENCY OF OCCURENCE TABLE ******

THICKNESS (METERS)	INVERSION BASE HEIGHT (IN METERS) SFC	100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	0	0	0	1	0	0	0	0	0	0	1
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											28
TOTAL	0	0	0	1	0	0	0	0	0	0	29
---TIME 601-1200 MST											
001-100	0	0	0	1	0	0	0	0	0	0	1
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											26
TOTAL	0	0	0	1	0	0	0	0	0	0	27
---TIME 1201-1800 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											29
TOTAL	0	0	0	0	0	0	0	0	0	0	29
---TIME 1801-2400 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											29
TOTAL	0	0	0	0	0	0	0	0	0	0	29
---------- FREQUENCY SUMMARY FOR SECOND INVERSION ----------											
001-100	0	0	0	2	0	0	0	0	0	0	2
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											112
TOTAL	0	0	0	2	0	0	0	0	0	0	114

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METECROLOGICAL STUDY MCNTH CF APRIL 1977

********* TWO HCUR STABILITY ANALYSIS **********

DAY	HOUR 02	04	06	08	10	12	14	16	18	20	22	24
1	E	E	E	E	D	C	C	C	C	E	E	E
2	F	E	E	E	D	D	C	C	C	E	E	E
3	F	E	E	E	D	B	C	C	C	D	E	E
4	F	E	E	E	D	C	C	C	C	D	F	F
5	F	F	F	F	C	D	C	C	C	D	F	F
6	F	F	F	F	E	D	C	C	C	D	F	F
7	F	F	F	F	E	D	C	C	C	D	F	F
8	F	E	E	F	D	C	C	C	C	D	D	D
9	E	E	E	D	C	C	C	C	D	F	F	F
10	F	E	E	D	C	C	C	C	C	E	E	E
11	E	E	E	E	D	C	C	C	C	D	F	F
12	F	F	F	D	M	M	M	M	M	M	M	M
13	M	M	M	M	D	M	C	D	D	E	E	E
14	E	E	E	D	C	C	C	E	E	F	F	F
15	F	F	F	D	C	C	C	C	D	D	D	E
16	M	M	M	M	D	M	M	M	M	M	M	M
17	M	M	M	D	C	C	C	C	C	D	F	F
18	F	F	F	F	D	C	C	C	C	D	E	E
19	E	F	F	D	C	C	C	E	B	D	D	D
20	E	M	M	M	M	M	M	C	C	D	E	E
21	E	E	E	E	D	C	C	C	C	D	E	E
22	E	E	E	E	D	C	C	C	C	D	E	E
23	E	E	E	E	D	C	C	B	D	E	E	E
24	E	E	E	E	D	C	C	C	D	M	M	M
25	M	M	M	M	D	M	M	M	M	D	M	M
26	E	E	E	D	C	C	C	C	C	D	F	F
27	F	F	M	M	M	M	M	M	M	M	M	M
28	M	M	M	M	M	M	M	C	C	D	F	F
29	E	F	F	D	C	C	C	B	B	D	M	M
30	M	M	M	M	D	M	M	M	M	D	M	M

PERCENT FREQUENCY CF CCCURENCE FOR EACH CATEGORY

A= 0.0 % B= 2.6 % C=23.9 % D=16.1 % E=20.8 % F=15.6 %

U= 0.0 % M=20.8 %

NOTE: U=UNKNOWN M=MISSING DATA
CLOUD COVER CONDITIONS USED FRCM NWS STATION AT KALISPELL
WIND DATA USED FRCM NWS STATION AT KALISPELL

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF MAY 1977

FIRST INVERSION

DAY	0000-0600 MST BASE (100M)	TOP (100M)	TYPE *	0601-1200 MST BASE (100M)	TOP (100M)	TYPE *	1201-1800 MST BASE (100M)	TOP (100M)	TYPE *	1801-2400 MST BASE (100M)	TOP (100M)	TYPE *
1	0	3	3	1	2	3	N	N	N	0	2	3
2	0	2	4	N	N	N	N	N	N	0	1	3
3	0	2	4	N	N	N	N	N	N	N	N	N
4	0	1	3	N	N	N	N	N	N	0	2	3
5	0	1	3	N	N	N	N	N	N	0	1	4
6	0	3	4	N	N	N	N	N	N	N	N	N
7	0	4	4	N	N	N	N	N	N	0	2	4
8	0	2	4	N	N	N	N	N	N	0	2	3
9	0	3	4	3	4	3	N	N	N	0	3	3
10	0	2	4	2	3	4	N	N	N	N	N	N
11	0	2	3	N	N	N	N	N	N	0	1	4
12	0	3	4	2	3	4	N	N	N	0	2	4
13	0	1	4	N	N	N	N	N	N	0	2	4
14	0	2	4	0	2	4	N	N	N	1	2	3
15	0	1	3	N	N	N	N	N	N	0	2	4
16	0	3	4	N	N	N	N	N	N	0	1	3
17	N	N	N	N	N	N	N	N	N	N	N	N
18	0	1	4	N	N	N	N	N	N	N	N	N
19	0	2	4	N	N	N	N	N	N	0	2	3
20	0	2	4	N	N	N	N	N	N	0	1	4
21	0	2	4	0	3	4	N	N	N	0	2	4
22	0	2	4	3	4	4	N	N	N	N	N	N
23	0	3	4	0	2	3	N	N	N	N	N	N
24	0	2	4	0	2	4	N	N	N	N	N	N
25	0	3	4	0	2	4	N	N	N	0	1	3
26	0	4	4	0	3	4	N	N	N	0	1	4
27	0	2	4	N	N	N	N	N	N	0	2	4
28	0	1	3	N	N	N	N	N	N	0	2	4
29	0	2	3	N	N	N	N	N	N	0	1	4
30	0	2	3	0	3	4	N	N	N	0	1	4
31	0	1	4	0	3	4	N	N	N	N	N	N

SECOND INVERSION

DAY	0000-0600 MST BASE (100M)	TOP (100M)	TYPE *	0601-1200 MST BASE (100M)	TOP (100M)	TYPE *	1201-1800 MST BASE (100M)	TOP (100M)	TYPE *	1801-2400 MST BASE (100M)	TOP (100M)	TYPE *
1	N	N	N	N	N	N	N	N	N	N	N	N
2	N	N	N	N	N	N	N	N	N	N	N	N
3	N	N	N	N	N	N	N	N	N	N	N	N
4	N	N	N	N	N	N	N	N	N	N	N	N
5	N	N	N	N	N	N	N	N	N	N	N	N
6	N	N	N	N	N	N	N	N	N	N	N	N
7	N	N	N	N	N	N	N	N	N	N	N	N
8	N	N	N	N	N	N	N	N	N	N	N	N
9	N	N	N	N	N	N	N	N	N	N	N	N
10	N	N	N	N	N	N	N	N	N	N	N	N
11	N	N	N	N	N	N	N	N	N	N	N	N
12	N	N	N	N	N	N	N	N	N	N	N	N
13	N	N	N	N	N	N	N	N	N	N	N	N
14	N	N	N	N	N	N	N	N	N	N	N	N
15	2	3	9	N	N	N	N	N	N	N	N	N
16	N	N	N	N	N	N	N	N	N	N	N	N
17	N	N	N	N	N	N	N	N	N	N	N	N
18	N	N	N	N	N	N	N	N	N	N	N	N
19	N	N	N	N	N	N	N	N	N	N	N	N
20	N	N	N	N	N	N	N	N	N	N	N	N
21	N	N	N	N	N	N	N	N	N	N	N	N
22	N	N	N	N	N	N	N	N	N	N	N	N
23	N	N	N	N	N	N	N	N	N	N	N	N
24	N	N	N	N	N	N	N	N	N	N	N	N
25	N	N	N	N	N	N	N	N	N	N	N	N
26	N	N	N	N	N	N	N	N	N	N	N	N
27	N	N	N	N	N	N	N	N	N	N	N	N
28	N	N	N	N	N	N	N	N	N	N	N	N
29	N	N	N	N	N	N	N	N	N	N	N	N
30	3	4	9	N	N	N	N	N	N	N	N	N
31	N	N	N	N	N	N	N	N	N	N	N	N

NOTE: FOR TYPE 1=FRONTAL, 2=SUBSIDENCE, 3=RADIATION (SPIKED ECHO)
4=RADIATION (LAMINAR ECHO) 9=UNKNOWN
N=NO INVERSION M=MISSING DATA OR UNKNOWN

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF MAY 1977

******* FIRST INVERSION FREQUENCY OF OCCURENCE TABLE *******

THICKNESS (METERS)	INVERSION BASE HEIGHT (IN METERS) SFC	100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	7	0	0	0	0	0	0	0	0	0	7
101-300	21	0	0	0	0	0	0	0	0	0	21
301-500	2	0	0	0	0	0	0	0	0	0	2
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											1
TOTAL	30	0	0	0	0	0	0	0	0	0	31
---TIME 601-1200 MST											
001-100	0	1	2	2	0	0	0	0	0	0	5
101-300	8	0	0	0	0	0	0	0	0	0	8
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											18
TOTAL	8	1	2	2	0	0	0	0	0	0	31
---TIME 1201-1800 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											31
TOTAL	0	0	0	0	0	0	0	0	0	0	31
---TIME 1801-2400 MST											
001-100	9	1	0	0	0	0	0	0	0	0	10
101-300	12	0	0	0	0	0	0	0	0	0	12
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											9
TOTAL	21	1	0	0	0	0	0	0	0	0	31
---------- FREQUENCY SUMMARY FOR FIRST INVERSION ----------											
001-100	16	2	2	2	0	0	0	0	0	0	22
101-300	41	0	0	0	0	0	0	0	0	0	41
301-500	2	0	0	0	0	0	0	0	0	0	2
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											59
TOTAL	59	2	2	2	0	0	0	0	0	0	124

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF MAY 1977

******* SECOND INVERSION FREQUENCY OF OCCURENCE TABLE ******

THICKNESS (METERS)	INVERSION BASE HEIGHT (IN METERS) SFC	100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	0	0	1	1	0	0	0	0	0	0	2
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											29
TOTAL	0	0	1	1	0	0	0	0	0	0	31
---TIME 601-1200 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											31
TOTAL	0	0	0	0	0	0	0	0	0	0	31
---TIME 1201-1800 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											31
TOTAL	0	0	0	0	0	0	0	0	0	0	31
---TIME 1801-2400 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											31
TOTAL	0	0	0	0	0	0	0	0	0	0	31
---------- FREQUENCY SUMMARY FOR SECOND INVERSION ----------											
001-100	0	0	1	1	0	0	0	0	0	0	2
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											122
TOTAL	0	0	1	1	0	0	0	0	0	0	124

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF MAY 1977

********* TWO HOUR STABILITY ANALYSIS **********

DAY	HOUR 02	04	06	08	10	12	14	16	18	20	22	24
1	E	E	E	E	D	C	C	C	C	D	E	E
2	E	E	D	D	D	D	D	D	D	D	E	E
3	E	E	D	D	D	C	M	M	D	D	D	D
4	M	M	M	D	M	M	D	M	M	E	E	E
5	E	E	E	D	C	C	C	C	C	D	F	F
6	F	E	E	E	D	C	D	D	D	D	D	D
7	E	E	E	E	D	C	C	C	D	F	E	E
8	E	E	E	E	D	C	C	C	C	D	E	E
9	F	F	F	E	C	D	C	C	C	E	E	E
10	E	E	E	D	C	D	C	D	D	D	D	D
11	M	D	D	D	M	M	M	M	M	D	M	M
12	M	M	M	D	C	C	C	C	C	D	E	E
13	E	E	E	D	C	C	C	C	C	D	E	E
14	E	E	E	E	D	D	C	C	C	D	E	E
15	E	E	E	D	B	E	C	C	D	D	F	F
16	F	F	F	F	D	C	C	C	C	D	D	D
17	D	D	D	D	C	C	D	C	C	D	D	E
18	D	E	E	D	C	C	C	C	C	D	E	E
19	E	E	E	E	D	B	C	D	C	D	E	E
20	E	E	E	E	D	C	C	C	C	C	F	F
21	F	E	E	E	D	D	C	D	D	D	E	E
22	E	E	E	F	D	C	C	C	C	D	D	E
23	E	E	E	E	D	C	C	D	D	D	D	E
24	E	E	E	E	D	C	C	C	C	D	D	E
25	E	E	E	E	D	C	C	C	C	D	F	F
26	F	E	E	E	D	C	D	D	C	D	E	E
27	E	E	E	D	C	C	C	C	C	C	F	F
28	E	F	F	E	D	C	C	C	C	D	E	E
29	E	E	E	E	D	D	D	D	D	D	E	E
30	F	F	F	F	D	C	C	C	C	D	E	E
31	E	E	E	E	D	B	C	C	C	D	D	F

PERCENT FREQUENCY OF OCCURENCE FOR EACH CATEGORY

A= 0.0 % B= 1.1 % C=25.0 % D=29.0 % E=31.7 % F= 7.8 %

U= 0.0 % M= 5.4 %

NOTE: U=UNKNOWN M=MISSING DATA
CLOUD COVER CONDITIONS USED FROM NWS STATION AT KALISPELL
WIND DATA USED FROM NWS STATION AT KALISPELL

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF JUNE 1977

**********FIRST INVERSION**********

DAY	0000-0600 MST BASE (100M)	TOP (100M)	TYPE *	0601-1200 MST BASE (100M)	TOP (100M)	TYPE *	1201-1800 MST BASE (100M)	TOP (100M)	TYPE *	1801-2400 MST BASE (100M)	TOP (100M)	TYPE *
1	0	5	4	2	3	4	N	N	N	N	N	N
2	0	3	3	N	N	N	N	N	N	N	N	N
3	0	3	4	2	3	4	N	N	N	N	N	N
4	N	N	N	N	N	N	N	N	N	N	N	N
5	0	3	4	N	N	N	N	N	N	N	N	N
6	0	4	4	N	N	N	N	N	N	N	N	N
7	0	2	4	1	2	4	N	N	N	N	N	N
8	0	3	4	N	N	N	N	N	N	0	1	3
9	0	2	4	0	3	4	N	N	N	0	1	3
10	0	2	4	N	N	N	N	N	N	1	3	3
11	0	3	3	1	2	3	N	N	N	N	N	N
12	0	2	4	2	3	4	N	N	N	N	N	N
13	0	4	4	2	4	4	N	N	N	0	2	4
14	0	3	4	N	N	N	N	N	N	N	N	N
15	0	3	4	2	3	4	N	N	N	N	N	N
16	0	4	4	N	N	N	N	N	N	N	N	N
17	N	N	N	N	N	N	M	M	M	M	M	M
18	M	M	M	M	M	M	M	M	M	M	M	M
19	M	M	M	M	M	M	M	M	M	M	M	M
20	M	M	M	M	M	M	M	M	M	M	M	M
21	0	2	4	0	2	4	N	N	N	N	N	N
22	0	2	4	0	2	4	N	N	N	N	N	N
23	0	3	4	N	N	N	N	N	N	N	N	N
24	0	3	4	N	N	N	N	N	N	0	1	4
25	0	4	4	N	N	N	N	N	N	0	2	4
26	0	3	4	N	N	N	N	N	N	0	1	3
27	0	2	3	N	N	N	N	N	N	0	1	4
28	0	2	4	0	3	4	N	N	N	N	N	N
29	0	1	3	N	N	N	N	N	N	N	N	N
30	0	3	4	N	N	N	N	N	N	N	N	N

**********SECOND INVERSION**********

DAY	0000-0600 MST EASE (100M)	TOP (100M)	TYPE *	0601-1200 MST BASE (100M)	TOP (100M)	TYPE *	1201-1800 MST EASE (100M)	TOP (100M)	TYPE *	1801-2400 MST EASE (100M)	TOP (100M)	TYPE *
1	N	N	N	N	N	N	N	N	N	N	N	N
2	N	N	N	N	N	N	N	N	N	N	N	N
3	N	N	N	N	N	N	N	N	N	N	N	N
4	N	N	N	N	N	N	N	N	N	N	N	N
5	N	N	N	N	N	N	N	N	N	N	N	N
6	N	N	N	N	N	N	N	N	N	N	N	N
7	N	N	N	N	N	N	N	N	N	N	N	N
8	N	N	N	N	N	N	N	N	N	N	N	N
9	N	N	N	N	N	N	N	N	N	N	N	N
10	N	N	N	N	N	N	N	N	N	N	N	N
11	N	N	N	N	N	N	N	N	N	N	N	N
12	N	N	N	N	N	N	N	N	N	N	N	N
13	N	N	N	N	N	N	N	N	N	N	N	N
14	N	N	N	N	N	N	N	N	N	N	N	N
15	N	N	N	N	N	N	N	N	N	N	N	N
16	N	N	N	N	N	N	N	N	N	N	N	N
17	N	N	N	N	N	N	M	M	M	M	M	M
18	M	M	M	M	M	M	M	M	M	M	M	M
19	M	M	M	M	M	M	M	M	M	M	M	M
20	M	M	M	M	M	M	M	M	M	M	M	M
21	N	N	N	N	N	N	N	N	N	N	N	N
22	N	N	N	3	4	5	N	N	N	N	N	N
23	N	N	N	N	N	N	N	N	N	N	N	N
24	N	N	N	N	N	N	N	N	N	N	N	N
25	N	N	N	N	N	N	N	N	N	N	N	N
26	N	N	N	N	N	N	N	N	N	N	N	N
27	N	N	N	N	N	N	N	N	N	N	N	N
28	3	4	5	3	4	5	N	N	N	N	N	N
29	N	N	N	N	N	N	N	N	N	N	N	N
30	N	N	N	N	N	N	N	N	N	N	N	N

NOTE: FOR TYPE 1=FRONTAL, 2=SUBSIDENCE, 3=RADIATION (SPIKED ECHO)
4=RADIATION (LAMINAR ECHO) 9=UNKNOWN
N=NO INVERSION M=MISSING DATA OR UNKNOWN

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF JUNE 1977

******* FIRST INVERSION FREQUENCY OF OCCURENCE TABLE *******

THICKNESS (METERS)	INVERSION BASE HEIGHT (IN METERS) SFC	100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	1	0	0	0	0	0	0	0	0	0	1
101-300	19	0	0	0	0	0	0	0	0	0	19
301-500	5	0	0	0	0	0	0	0	0	0	5
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											2
TOTAL	25	0	0	0	0	0	0	0	0	0	27
---TIME 601-1200 MST											
001-100	0	2	4	0	0	0	0	0	0	0	6
101-300	4	0	1	0	0	0	0	0	0	0	5
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											16
TOTAL	4	2	5	0	0	0	0	0	0	0	27
---TIME 1201-1800 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											26
TOTAL	0	0	0	0	0	0	0	0	0	0	26
---TIME 1801-2400 MST											
001-100	5	0	0	0	0	0	0	0	0	0	5
101-300	2	1	0	0	0	0	0	0	0	0	3
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											18
TOTAL	7	1	0	0	0	0	0	0	0	0	26
---------- FREQUENCY SUMMARY FOR FIRST INVERSION ----------											
001-100	6	2	4	0	0	0	0	0	0	0	12
101-300	25	1	1	0	0	0	0	0	0	0	27
301-500	5	0	0	0	0	0	0	0	0	0	5
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											62
TOTAL	36	3	5	0	0	0	0	0	0	0	106

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF JUNE 1977

******* SECOND INVERSION FREQUENCY OF OCCURENCE TABLE ******

THICKNESS (METERS)	INVERSION BASE HEIGHT (IN METERS) SFC	100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	0	0	0	1	0	0	0	0	0	0	1
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											26
TOTAL	0	0	0	1	0	0	0	0	0	0	27
---TIME 601-1200 MST											
001-100	0	0	0	2	0	0	0	0	0	0	2
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											25
TOTAL	0	0	0	2	0	0	0	0	0	0	27
---TIME 1201-1800 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											26
TOTAL	0	0	0	0	0	0	0	0	0	0	26
---TIME 1801-2400 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											26
TOTAL	0	0	0	0	0	0	0	0	0	0	26
---------- FREQUENCY SUMMARY FOR SECOND INVERSION ----------											
001-100	0	0	0	3	0	0	0	0	0	0	3
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											103
TOTAL	0	0	0	3	0	0	0	0	0	0	106

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF JUNE 1977

********* TWO HOUR STABILITY ANALYSIS **********

DAY	HOUR 02	04	06	08	10	12	14	16	18	20	22	24
1	F	F	F	D	C	C	D	D	D	D	D	D
2	E	E	E	D	C	C	C	C	C	D	D	E
3	E	E	E	E	D	E	C	C	D	D	D	E
4	D	D	D	D	C	C	C	C	C	D	D	E
5	D	F	F	F	D	A	B	B	B	C	D	F
6	F	E	E	E	D	C	C	C	C	C	D	F
7	E	E	E	E	D	E	C	C	D	D	D	E
8	E	D	D	D	D	C	D	C	C	D	F	F
9	F	F	F	F	D	C	C	C	C	D	F	F
10	F	E	E	D	C	C	C	C	C	D	E	E
11	E	E	E	E	D	B	C	C	C	D	D	F
12	F	F	F	E	D	C	C	C	C	C	D	E
13	E	F	F	E	D	C	C	C	C	C	F	F
14	F	E	E	F	D	C	C	C	D	D	D	F
15	E	E	E	D	C	C	C	C	C	D	D	E
16	E	E	E	D	C	C	C	D	D	D	F	F
17	F	F	F	F	D	M	M	M	M	M	M	M
18	M	M	M	M	M	M	M	M	M	M	M	M
19	M	M	M	M	M	M	M	M	M	M	M	M
20	M	M	M	M	M	M	M	M	M	M	M	M
21	F	E	E	E	D	C	C	C	C	D	D	F
22	F	F	F	E	E	D	C	C	C	D	D	E
23	F	F	F	D	C	C	C	C	C	D	D	E
24	F	E	E	D	C	C	C	C	C	D	F	F
25	F	E	E	E	D	C	C	C	C	D	E	E
26	E	F	F	E	D	C	C	C	C	D	E	E
27	F	E	E	D	C	C	C	C	C	D	F	F
28	F	E	E	E	D	C	C	C	C	D	E	E
29	E	F	F	D	C	C	C	C	C	C	D	F
30	F	F	F	F	C	C	C	C	C	C	D	F

PERCENT FREQUENCY OF OCCURENCE FOR EACH CATEGORY

A= 0.3 % B= 1.7 % C=28.9 % D=21.9 % E=18.3 % F=16.9 %

U= 0.0 % M=11.9 %

NOTE: U=UNKNOWN M=MISSING DATA
CLOUD COVER CONDITIONS USED FROM NWS STATION AT KALISPELL
WIND DATA USED FROM NWS STATION AT KALISPELL

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METECROLOGICAL STUDY — MONTH OF JULY 1977

FIRST INVERSION

DAY	0000-0600 MST BASE (100M)	0000-0600 MST TOP (100M)	0000-0600 MST TYPE *	0601-1200 MST BASE (100M)	0601-1200 MST TOP (100M)	0601-1200 MST TYPE *	1201-1800 MST BASE (100M)	1201-1800 MST TOP (100M)	1201-1800 MST TYPE *	1801-2400 MST BASE (100M)	1801-2400 MST TOP (100M)	1801-2400 MST TYPE *
1	0	3	4	3	4	4	N	N	N	0	1	3
2	0	2	3	N	N	N	N	N	N	0	1	3
3	0	3	4	N	N	N	N	N	N	N	N	N
4	0	1	3	N	N	N	N	N	N	N	N	N
5	0	1	3	N	N	N	N	N	N	N	N	N
6	0	3	3	N	N	N	N	N	N	N	N	N
7	0	2	4	N	N	N	N	N	N	N	N	N
8	0	2	4	N	N	N	N	N	N	N	N	N
9	0	3	4	N	N	N	N	N	N	N	N	N
10	0	3	4	0	3	4	N	N	N	N	N	N
11	0	5	4	3	5	4	N	N	N	N	N	N
12	0	4	4	N	N	N	N	N	N	N	N	N
13	N	N	N	N	N	N	N	N	N	N	N	N
14	0	5	4	4	5	4	N	N	N	N	N	N
15	0	4	4	3	4	4	N	N	N	N	N	N
16	0	3	4	2	3	4	N	N	N	N	N	N
17	0	1	3	N	N	N	N	N	N	0	2	3
18	N	N	N	N	N	N	N	N	N	N	N	N
19	0	2	4	N	N	N	N	N	N	N	N	N
20	0	4	4	3	4	4	N	N	N	N	N	N
21	0	4	4	N	N	N	N	N	N	0	2	3
22	0	2	4	4	5	9	N	N	N	N	N	N
23	0	2	4	2	3	4	N	N	N	N	N	N
24	N	N	N	N	N	N	N	N	N	N	N	N
25	N	N	N	N	N	N	N	N	N	N	N	N
26	N	N	N	N	N	N	N	N	N	N	N	N
27	0	3	4	N	N	N	N	N	N	N	N	N
28	0	4	4	N	N	N	N	N	N	N	N	N
29	0	2	3	N	N	N	N	N	N	M	M	M
30	M	M	M	M	M	M	M	M	M	M	M	M
31	M	M	M	M	M	M	M	M	M	M	M	M

SECOND INVERSION

DAY	0000-0600 MST BASE (100M)	0000-0600 MST TOP (100M)	0000-0600 MST TYPE *	0601-1200 MST EASE (100M)	0601-1200 MST TOP (100M)	0601-1200 MST TYPE *	1201-1800 MST BASE (100M)	1201-1800 MST TOP (100M)	1201-1800 MST TYPE *	1801-2400 MST EASE (100M)	1801-2400 MST TOP (100M)	1801-2400 MST TYPE *
1	N	N	N	N	N	N	N	N	N	N	N	N
2	N	N	N	N	N	N	N	N	N	N	N	N
3	N	N	N	N	N	N	N	N	N	N	N	N
4	N	N	N	N	N	N	N	N	N	N	N	N
5	N	N	N	N	N	N	N	N	N	N	N	N
6	N	N	N	N	N	N	N	N	N	N	N	N
7	N	N	N	N	N	N	N	N	N	N	N	N
8	N	N	N	N	N	N	N	N	N	N	N	N
9	N	N	N	N	N	N	N	N	N	N	N	N
10	N	N	N	N	N	N	N	N	N	N	N	N
11	N	N	N	N	N	N	N	N	N	N	N	N
12	N	N	N	N	N	N	N	N	N	N	N	N
13	N	N	N	N	N	N	N	N	N	N	N	N
14	N	N	N	N	N	N	N	N	N	N	N	N
15	N	N	N	N	N	N	N	N	N	N	N	N
16	N	N	N	N	N	N	N	N	N	N	N	N
17	N	N	N	N	N	N	N	N	N	N	N	N
18	N	N	N	N	N	N	N	N	N	N	N	N
19	N	N	N	N	N	N	N	N	N	N	N	N
20	N	N	N	N	N	N	N	N	N	N	N	N
21	N	N	N	N	N	N	N	N	N	N	N	N
22	N	N	N	N	N	N	N	N	N	N	N	N
23	N	N	N	N	N	N	N	N	N	N	N	N
24	N	N	N	N	N	N	N	N	N	N	N	N
25	N	N	N	N	N	N	N	N	N	N	N	N
26	N	N	N	N	N	N	N	N	N	N	N	N
27	N	N	N	N	N	N	N	N	N	N	N	N
28	N	N	N	N	N	N	N	N	N	N	N	N
29	N	N	N	N	N	N	N	N	N	M	M	M
30	M	M	M	M	M	M	M	M	M	M	M	M
31	M	M	M	M	M	M	M	M	M	M	M	M

NOTE: FOR TYPE 1=FRONTAL, 2=SUBSIDENCE, 3=RADIATION (SPIKED ECHO)
4=RADIATION (LAMINAR ECHO) 9=UNKNOWN
N=NO INVERSION M=MISSING DATA OR UNKNOWN

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF JULY 1977

******* FIRST INVERSION FREQUENCY OF OCCURENCE TABLE *******

THICKNESS (METERS)	SFC	INVERSION BASE HEIGHT (IN METERS) 100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	3	0	0	0	0	0	0	0	0	0	3
101-300	14	0	0	0	0	0	0	0	0	0	14
301-500	7	0	0	0	0	0	0	0	0	0	7
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											5
TOTAL	24	0	0	0	0	0	0	0	0	0	29
---TIME 601-1200 MST											
001-100	0	0	2	3	2	0	0	0	0	0	7
101-300	1	0	0	1	0	0	0	0	0	0	2
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											20
TOTAL	1	0	2	4	2	0	0	0	0	0	29
---TIME 1201-1800 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											29
TOTAL	0	0	0	0	0	0	0	0	0	0	29
---TIME 1801-2400 MST											
001-100	2	0	0	0	0	0	0	0	0	0	2
101-300	2	0	0	0	0	0	0	0	0	0	2
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											24
TOTAL	4	0	0	0	0	0	0	0	0	0	28
---------- FREQUENCY SUMMARY FOR FIRST INVERSION ----------											
001-100	5	0	2	3	2	0	0	0	0	0	12
101-300	17	0	0	1	0	0	0	0	0	0	18
301-500	7	0	0	0	0	0	0	0	0	0	7
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											78
TOTAL	29	0	2	4	2	0	0	0	0	0	115

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF JULY 1977

******* SECOND INVERSION FREQUENCY OF OCCURENCE TABLE ******

THICKNESS (METERS)	INVERSION BASE HEIGHT (IN METERS) SFC	100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											29
TOTAL	0	0	0	0	0	0	0	0	0	0	29
---TIME 601-1200 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											29
TOTAL	0	0	0	0	0	0	0	0	0	0	29
---TIME 1201-1800 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											29
TOTAL	0	0	0	0	0	0	0	0	0	0	29
---TIME 1801-2400 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											28
TOTAL	0	0	0	0	0	0	0	0	0	0	28
---------- FREQUENCY SUMMARY FOR SECOND INVERSION ----------											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											115
TOTAL	0	0	0	0	0	0	0	0	0	0	115

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METECROLCGICAL STUDY MONTH OF JULY 1977

********* TWO HOUR STABILITY ANALYSIS **********

DAY	HOUR 02	04	06	08	10	12	14	16	18	20	22	24
1	F	E	E	E	D	C	C	C	D	D	E	E
2	E	E	E	D	C	C	C	C	C	C	F	F
3	E	E	E	E	D	C	C	C	C	D	D	E
4	E	E	E	F	D	B	C	D	D	D	D	E
5	E	E	E	D	C	C	C	C	C	D	D	E
6	E	E	E	D	D	C	C	C	C	D	E	E
7	E	F	F	F	D	C	C	B	C	C	E	E
8	E	F	F	D	C	C	C	C	C	D	F	F
9	F	E	E	D	D	D	C	C	D	D	E	E
10	M	M	M	M	D	M	D	D	D	D	D	M
11	M	M	M	E	D	C	C	C	C	D	E	E
12	E	E	E	E	D	C	C	C	C	D	E	E
13	D	D	D	D	C	D	D	C	C	D	D	F
14	F	F	F	F	D	C	C	C	C	D	D	F
15	F	F	F	F	D	C	C	C	C	D	F	F
16	F	F	F	E	D	C	C	C	C	D	E	E
17	E	D	D	D	C	D	D	D	D	E	E	D
18	D	D	D	D	C	C	C	C	C	C	D	E
19	E	F	F	F	D	D	D	C	C	C	D	F
20	F	F	F	D	C	B	B	C	C	C	D	F
21	F	E	E	E	D	C	C	C	C	D	E	E
22	F	F	F	F	D	C	C	C	C	D	F	F
23	E	E	E	F	D	C	C	C	C	D	F	F
24	D	D	D	D	C	C	C	C	C	D	D	E
25	D	D	D	D	D	C	D	C	D	D	D	D
26	D	D	D	D	D	D	D	D	C	D	D	E
27	E	F	F	D	C	C	C	C	C	C	E	E
28	F	E	E	D	C	C	C	C	C	C	E	E
29	E	E	E	D	C	C	C	M	M	M	M	M
30	M	M	M	M	M	M	M	M	M	M	M	M
31	M	M	M	M	M	M	M	M	M	M	M	M

PERCENT FREQUENCY OF OCCURENCE FOR EACH CATEGORY

A= 0.0 % B= 1.1 % C=28.5 % D=28.2 % E=19.1 % F=12.9 %

U= 0.0 % M=10.2 %

NOTE: U=UNKNOWN M=MISSING DATA
CLOUD COVER CONDITIONS USED FROM NWS STATION AT KALISPELL
WIND DATA USED FROM NWS STATION AT KALISPELL

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY — MONTH OF AUGUST 1977

FIRST INVERSION

DAY	0000-0600 MST BASE (100M)	0000-0600 MST TOP (100M)	0000-0600 MST TYPE *	0601-1200 MST BASE (100M)	0601-1200 MST TOP (100M)	0601-1200 MST TYPE *	1201-1800 MST BASE (100M)	1201-1800 MST TOP (100M)	1201-1800 MST TYPE *	1801-2400 MST BASE (100M)	1801-2400 MST TOP (100M)	1801-2400 MST TYPE *
1	M	M	M	M	M	M	M	M	M	M	M	M
2	M	M	M	M	M	M	N	M	M	M	M	M
3	M	M	M	M	M	M	N	M	M	M	M	M
4	M	M	M	N	N	N	N	N	N	N	N	N
5	C	3	3	N	N	N	N	N	N	N	N	N
6	C	4	4	N	N	N	N	N	N	N	N	N
7	0	4	3	N	N	N	N	N	N	N	N	N
8	0	4	4	4	5	4	N	N	N	N	N	N
9	0	2	4	N	N	N	N	N	N	0	2	4
10	0	4	4	2	3	4	N	N	N	N	N	N
11	0	3	4	2	3	4	N	N	N	N	N	N
12	0	3	4	N	N	N	N	N	N	N	N	N
13	2	4	4	N	N	N	N	N	N	1	2	3
14	0	3	4	0	4	4	3	5	5	3	4	5
15	1	4	3	2	4	3	N	N	N	N	N	N
16	0	4	4	2	3	4	N	N	N	N	N	N
17	0	3	4	2	3	4	N	N	N	N	N	N
18	0	4	4	2	4	4	N	N	N	N	N	N
19	0	2	4	M	M	M	M	M	M	M	M	M
20	M	M	M	M	M	M	M	M	M	M	M	M
21	M	M	M	M	M	M	M	M	M	M	M	M
22	M	M	M	M	M	M	N	N	N	0	2	4
23	0	3	4	0	3	4	N	N	N	N	N	N
24	0	2	4	0	2	4	N	N	N	N	N	N
25	0	2	4	N	N	N	N	N	N	N	N	N
26	0	2	4	2	3	4	N	N	N	N	N	N
27	0	2	4	N	N	N	N	N	N	0	1	4
28	0	2	4	0	2	4	N	N	N	0	2	3
29	0	2	4	1	2	4	N	N	N	0	2	4
30	0	2	4	2	3	4	N	N	N	0	2	4
31	0	2	3	0	2	3	N	N	N	0	3	4

SECOND INVERSION

DAY	0000-0600 MST BASE (100M)	0000-0600 MST TOP (100M)	0000-0600 MST TYPE *	0601-1200 MST BASE (100M)	0601-1200 MST TOP (100M)	0601-1200 MST TYPE *	1201-1800 MST BASE (100M)	1201-1800 MST TOP (100M)	1201-1800 MST TYPE *	1801-2400 MST BASE (100M)	1801-2400 MST TOP (100M)	1801-2400 MST TYPE *
1	M	M	M	M	M	M	M	M	M	M	M	M
2	M	M	M	M	M	M	M	M	M	M	M	M
3	M	M	M	M	M	M	M	M	M	M	M	M
4	M	M	M	N	N	N	N	N	N	N	N	N
5	N	N	N	N	N	N	N	N	N	N	N	N
6	N	N	N	N	N	N	N	N	N	N	N	N
7	N	N	N	N	N	N	N	N	N	N	N	N
8	N	N	N	N	N	N	N	N	N	N	N	N
9	N	N	N	N	N	N	N	N	N	N	N	N
10	N	N	N	N	N	N	N	N	N	N	N	N
11	N	N	N	N	N	N	N	N	N	N	N	N
12	N	N	N	N	N	N	N	N	N	N	N	N
13	N	N	N	N	N	N	N	N	N	N	N	N
14	N	N	N	N	N	N	N	N	N	N	N	N
15	N	N	N	N	N	N	N	N	N	N	N	N
16	N	N	N	N	N	N	N	N	N	N	N	N
17	N	N	N	N	N	N	N	N	N	N	N	N
18	N	N	N	N	N	N	N	N	N	N	N	N
19	N	N	N	M	M	M	M	M	M	M	M	M
20	M	M	M	M	M	M	M	M	M	M	M	M
21	M	M	M	M	M	M	M	M	M	M	M	M
22	N	N	N	N	N	N	N	N	N	N	N	N
23	N	N	N	N	N	N	N	N	N	N	N	N
24	3	4	4	N	N	N	N	N	N	N	N	N
25	N	N	N	N	N	N	N	N	N	N	N	N
26	N	N	N	N	N	N	N	N	N	N	N	N
27	N	N	N	N	N	N	N	N	N	N	N	N
28	N	N	N	N	N	N	N	N	N	N	N	N
29	N	N	N	N	N	N	N	N	N	N	N	N
30	N	N	N	N	N	N	N	N	N	N	N	N
31	N	N	N	N	N	N	N	N	N	N	N	N

NOTE: FOR TYPE 1=FRONTAL, 2=SUBSIDENCE, 3=RADIATION (SPIKED ECHO)
4=RADIATION (LAMINAR ECHO) 9=UNKNOWN
N=NO INVERSION M=MISSING DATA OR UNKNOWN

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF AUGUST 1977

******* FIRST INVERSION FREQUENCY OF OCCURENCE TABLE *******

THICKNESS (METERS)	INVERSION BASE HEIGHT (IN METERS) SFC	100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	16	1	1	0	0	0	0	0	0	0	18
301-500	6	0	0	0	0	0	0	0	0	0	6
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											0
TOTAL	22	1	1	0	0	0	0	0	0	0	24
---TIME 601-1200 MST											
001-100	0	1	6	0	1	0	0	0	0	0	8
101-300	4	0	2	0	0	0	0	0	0	0	6
301-500	1	0	0	0	0	0	0	0	0	0	1
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											9
TOTAL	5	1	8	0	1	0	0	0	0	0	24
---TIME 1201-1800 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	1	0	0	0	0	0	0	1
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											24
TOTAL	0	0	0	1	0	0	0	0	0	0	25
---TIME 1801-2400 MST											
001-100	1	1	0	1	0	0	0	0	0	0	3
101-300	6	0	0	0	0	0	0	0	0	0	6
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											16
TOTAL	7	1	0	1	0	0	0	0	0	0	25
---------- FREQUENCY SUMMARY FOR FIRST INVERSION ----------											
001-100	1	2	6	1	1	0	0	0	0	0	11
101-300	26	1	3	1	0	0	0	0	0	0	31
301-500	7	0	0	0	0	0	0	0	0	0	7
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											49
TOTAL	34	3	9	2	1	0	0	0	0	0	98

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF AUGUST 1977

****** SECOND INVERSION FREQUENCY OF OCCURENCE TABLE ******

THICKNESS (METERS)	INVERSION BASE HEIGHT (IN METERS) SFC	100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	0	0	0	1	0	0	0	0	0	0	1
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											23
TOTAL	0	0	0	1	0	0	0	0	0	0	24
---TIME 601-1200 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											24
TOTAL	0	0	0	0	0	0	0	0	0	0	24
---TIME 1201-1800 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											25
TOTAL	0	0	0	0	0	0	0	0	0	0	25
---TIME 1801-2400 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											25
TOTAL	0	0	0	0	0	0	0	0	0	0	25
---------- FREQUENCY SUMMARY FOR SECOND INVERSION ----------											
001-100	0	0	0	1	0	0	0	0	0	0	1
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											97
TOTAL	0	0	0	1	0	0	0	0	0	0	98

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METECROLCGICAL STUDY MCNTH CF AUGUST 1977

********* TWO HCUF STABILITY ANALYSIS **********

DAY	HOUR 02	04	06	08	10	12	14	16	18	20	22	24
1	M	M	M	M	M	M	M	M	M	M	M	M
2	M	M	M	M	M	M	M	M	M	M	M	M
3	M	M	M	M	M	M	M	M	M	M	M	M
4	M	M	M	M	M	C	C	C	C	D	D	E
5	E	E	E	E	D	C	C	C	C	C	F	F
6	F	F	F	E	D	B	C	C	C	D	E	D
7	E	E	E	D	E	B	C	C	C	E	D	F
8	F	F	F	F	D	C	C	C	C	C	E	E
9	F	E	E	E	D	C	C	C	D	D	E	E
10	F	F	F	E	D	C	C	C	C	E	D	F
11	F	F	F	E	D	C	C	C	C	E	D	F
12	F	F	F	F	D	C	C	C	C	D	D	E
13	D	D	D	D	D	D	C	C	C	D	D	E
14	D	D	D	D	D	C	C	C	C	D	D	E
15	E	D	D	D	D	C	C	B	C	D	E	E
16	F	E	E	E	D	B	C	B	B	D	D	F
17	F	E	E	E	D	C	C	E	B	D	E	E
18	E	E	E	E	C	C	E	C	C	D	E	E
19	F	E	E	M	M	M	M	M	M	M	M	M
20	M	M	M	M	M	M	M	M	M	M	M	M
21	M	M	M	M	M	M	M	M	M	M	M	M
22	M	M	M	M	M	M	C	E	E	F	E	E
23	E	E	E	E	D	C	C	C	C	D	E	E
24	E	E	E	E	D	C	C	C	D	D	F	F
25	E	E	E	E	D	C	C	C	C	D	E	E
26	E	E	E	E	D	D	C	D	C	D	E	E
27	E	E	D	D	C	D	D	C	C	D	F	F
28	E	E	E	E	D	B	D	B	D	E	D	E
29	D	E	E	D	D	C	C	C	D	D	E	E
30	E	E	E	E	D	C	C	C	E	E	E	E
31	E	E	E	E	D	C	C	C	C	E	E	E

PERCENT FREQUENCY CF CCCURENCE FCR EACH CATEGCRY

A= 0.0 % B= 4.6 % C=21.2 % D=19.4 % E=24.7 % F= 8.6 %

U= 0.0 % M=21.5 %

NOTE: U=UNKNCWN M=MISSING DATA
CLOUD COVER CONDITIONS USED FROM NWS STATION AT KALISPELL
WIND DATA USED FROM NWS STATION AT KALISPELL

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF SEPT. 1977

********** FIRST INVERSION **********

DAY	0000-0600 MST BASE (100M)	TOP (100M)	TYPE *	0601-1200 MST BASE (100M)	TOP (100M)	TYPE *	1201-1800 MST BASE (100M)	TOP (100M)	TYPE *	1801-2400 MST BASE (100M)	TOP (100M)	TYPE *
1	0	4	4	3	4	4	N	N	N	0	3	4
2	0	3	4	4	5	4	N	N	N	0	2	4
3	0	2	4	1	2	4	N	N	N	0	2	4
4	0	3	4	2	3	4	0	2	4	N	N	N
5	0	2	4	N	N	N	N	N	N	0	2	4
6	0	4	4	3	4	4	N	N	N	0	2	4
7	0	3	4	2	4	4	N	N	N	N	N	N
8	0	3	3	N	N	N	N	N	N	0	1	4
9	0	2	4	2	4	4	N	N	N	0	1	4
10	0	3	4	N	N	N	N	N	N	0	1	4
11	0	2	4	2	3	4	N	N	N	N	N	N
12	0	4	4	3	4	4	N	N	N	N	N	N
13	0	2	4	2	4	4	N	N	N	0	1	4
14	0	3	4	2	3	4	N	N	N	0	1	4
15	0	2	4	M	M	M	M	M	M	M	M	M
16	M	M	M	M	M	M	M	M	M	M	M	M
17	M	M	M	M	M	M	M	M	M	M	M	M
18	M	M	M	M	M	M	M	M	M	M	M	M
19	M	M	M	M	M	M	M	M	M	M	M	M
20	M	M	M	M	M	M	M	M	M	M	M	M
21	M	M	M	M	M	M	M	M	M	M	M	M
22	M	M	M	M	M	M	M	M	M	M	M	M
23	M	M	M	M	M	M	M	M	M	M	M	M
24	M	M	M	M	M	M	M	M	M	M	M	M
25	M	M	M	M	M	M	M	M	M	M	M	M
26	M	M	M	M	M	M	N	N	N	N	N	N
27	0	3	4	3	4	4	N	N	N	0	1	4
28	N	N	N	N	N	N	N	N	N	N	N	N
29	2	3	9	1	2	9	N	N	N	0	1	4
30	0	2	4	0	2	4	N	N	N	0	1	4

********** SECOND INVERSION **********

DAY	0000-0600 MST BASE (100M)	TOP (100M)	TYPE *	0601-1200 MST BASE (100M)	TOP (100M)	TYPE *	1201-1800 MST BASE (100M)	TOP (100M)	TYPE *	1801-2400 MST BASE (100M)	TOP (100M)	TYPE *
1	N	N	N	N	N	N	N	N	N	N	N	N
2	N	N	N	N	N	N	N	N	N	N	N	N
3	N	N	N	N	N	N	N	N	N	N	N	N
4	N	N	N	N	N	N	N	N	N	N	N	N
5	N	N	N	N	N	N	N	N	N	N	N	N
6	N	N	N	N	N	N	N	N	N	N	N	N
7	N	N	N	N	N	N	N	N	N	N	N	N
8	N	N	N	N	N	N	N	N	N	N	N	N
9	N	N	N	N	N	N	N	N	N	N	N	N
10	N	N	N	N	N	N	N	N	N	N	N	N
11	N	N	N	N	N	N	N	N	N	N	N	N
12	N	N	N	N	N	N	N	N	N	N	N	N
13	N	N	N	N	N	N	N	N	N	N	N	N
14	N	N	N	N	N	N	N	N	N	N	N	N
15	N	N	N	M	M	M	M	M	M	M	M	M
16	M	M	M	M	M	M	M	M	M	M	M	M
17	M	M	M	M	M	M	M	M	M	M	M	M
18	M	M	M	M	M	M	M	M	M	M	M	M
19	M	M	M	M	M	M	M	M	M	M	M	M
20	M	M	M	M	M	M	M	M	M	M	M	M
21	M	M	M	M	M	M	M	M	M	M	M	M
22	M	M	M	M	M	M	M	M	M	M	M	M
23	M	M	M	M	M	M	M	M	M	M	M	M
24	M	M	M	M	M	M	M	M	M	M	M	M
25	M	M	M	M	M	M	M	M	M	M	M	M
26	M	N	N	M	M	M	N	N	N	N	N	N
27	N	N	N	N	N	N	N	N	N	N	N	N
28	N	N	N	N	N	N	N	N	N	N	N	N
29	N	N	N	N	N	N	N	N	N	N	N	N
30	N	N	N	N	N	N	N	N	N	N	N	N

NOTE: FOR TYPE 1=FRONTAL, 2=SUBSIDENCE, 3=RADIATION (SPIKED ECHO)
4=RADIATION (LAMINAR ECHO) 9=UNKNOWN
N=NO INVERSION M=MISSING DATA OR UNKNOWN

ACCUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF SEPT. 1977

******* FIRST INVERSION FREQUENCY OF OCCURENCE TABLE *******

THICKNESS (METERS)	SFC	INVERSION BASE HEIGHT (IN METERS) 100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	0	0	1	0	0	0	0	0	0	0	1
101-300	14	0	0	0	0	0	0	0	0	0	14
301-500	3	0	0	0	0	0	0	0	0	0	3
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											1
TOTAL	17	0	1	0	0	0	0	0	0	0	19
---TIME 601-1200 MST											
001-100	0	2	3	4	1	0	0	0	0	0	10
101-300	1	0	3	0	0	0	0	0	0	0	4
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											4
TOTAL	1	2	6	4	1	0	0	0	0	0	18
---TIME 1201-1800 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	1	0	0	0	0	0	0	0	0	0	1
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											18
TOTAL	1	0	0	0	0	0	0	0	0	0	19
---TIME 1801-2400 MST											
001-100	8	0	0	0	0	0	0	0	0	0	8
101-300	5	0	0	0	0	0	0	0	0	0	5
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											6
TOTAL	13	0	0	0	0	0	0	0	0	0	19
---------- FREQUENCY SUMMARY FOR FIRST INVERSION ----------											
001-100	8	2	4	4	1	0	0	0	0	0	19
101-300	21	0	3	0	0	0	0	0	0	0	24
301-500	3	0	0	0	0	0	0	0	0	0	3
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											29
TOTAL	32	2	7	4	1	0	0	0	0	0	75

ACOUSTIC RADAR ANALYSIS

OLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF SEPT. 1977

****** SECOND INVERSION FREQUENCY OF OCCURENCE TABLE ******

THICKNESS (METERS)	SFC	INVERSION BASE HEIGHT (IN METERS) 100	200	300	400	500	600	700	800	900	TOTAL
--TIME 0- 600 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
0 INVERSION											19
TOTAL	0	0	0	0	0	0	0	0	0	0	19
--TIME 601-1200 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
0 INVERSION											18
TOTAL	0	0	0	0	0	0	0	0	0	0	18
--TIME 1201-1800 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
0 INVERSION											19
TOTAL	0	0	0	0	0	0	0	0	0	0	19
--TIME 1801-2400 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
0 INVERSION											19
TOTAL	0	0	0	0	0	0	0	0	0	0	19
FREQUENCY SUMMARY FOR SECOND INVERSION											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
0 INVERSION											75
TOTAL	0	0	0	0	0	0	0	0	0	0	75

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METECROLOGICAL STUDY MONTH OF SEPT. 1977

********* TWO HOUR STABILITY ANALYSIS **********

DAY	HOUR 02	04	06	08	10	12	14	16	18	20	22	24
1	F	E	E	F	D	C	C	C	C	D	M	M
2	M	M	M	M	C	M	M	M	M	M	M	M
3	D	D	D	D	D	C	C	C	D	E	E	E
4	E	D	D	D	D	B	C	D	D	D	E	E
5	E	D	D	D	D	C	C	C	D	F	F	F
6	F	F	F	F	D	B	C	C	D	F	F	F
7	F	F	F	F	D	C	C	C	D	D	E	E
8	E	E	D	D	C	C	C	C	D	E	F	F
9	F	F	F	F	D	C	C	C	C	D	F	F
10	F	E	E	F	D	C	B	C	C	D	E	E
11	F	F	F	E	D	C	C	C	C	D	D	F
12	F	F	F	F	D	B	C	C	C	D	F	F
13	F	F	F	F	D	B	C	C	C	D	F	F
14	F	F	F	F	D	C	C	C	C	D	E	E
15	E	E	E	M	M	M	M	M	M	M	M	M
16	M	M	M	M	M	M	M	M	M	M	M	M
17	M	M	M	M	M	M	M	M	M	M	M	M
18	M	M	M	M	M	M	M	M	M	M	M	M
19	M	M	M	M	M	M	M	M	M	M	M	M
20	M	M	M	M	M	M	M	M	M	M	M	M
21	M	M	M	M	M	M	M	M	M	M	M	M
22	M	M	M	M	M	M	M	M	M	M	M	M
23	M	M	M	M	M	M	M	M	M	M	M	M
24	M	M	M	M	M	M	M	M	M	M	M	M
25	M	M	M	M	M	M	M	M	M	M	M	M
26	M	M	M	M	M	M	M	C	D	D	E	E
27	F	E	E	F	D	C	C	C	D	E	D	D
28	D	D	D	D	D	D	D	D	D	D	D	D
29	D	D	D	D	D	D	D	D	D	E	D	E
30	E	E	E	E	D	C	C	D	D	E	E	E

PERCENT FREQUENCY OF OCCURENCE FOR EACH CATEGORY

A= 0.0 % B= 1.4 % C=13.1 % D=20.3 % E=10.6 % F=13.3 %

U= 0.0 % M=41.4 %

NOTE: U=UNKNOWN M=MISSING DATA
CLOUD COVER CONDITIONS USED FROM NWS STATION AT KALISPELL
WIND DATA USED FROM NWS STATION AT KALISPELL

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY — MONTH OF OCTOBER 1977

FIRST INVERSION

DAY	0000-0600 MST BASE (100M)	0000-0600 MST TOP (100M)	0000-0600 MST TYPE *	0601-1200 MST BASE (100M)	0601-1200 MST TOP (100M)	0601-1200 MST TYPE *	1201-1800 MST BASE (100M)	1201-1800 MST TOP (100M)	1201-1800 MST TYPE *	1801-2400 MST BASE (100M)	1801-2400 MST TOP (100M)	1801-2400 MST TYPE *
1	0	1	3	0	2	4	N	N	N	0	2	4
2	0	2	4	0	3	4	N	N	N	0	2	4
3	0	3	4	0	3	4	N	N	N	0	2	4
4	0	3	4	0	4	4	N	N	N	0	2	4
5	0	3	4	0	3	4	N	N	N	0	3	4
6	0	3	4	0	3	4	N	N	N	0	1	3
7	0	1	4	N	N	N	N	N	N	0	1	4
8	0	1	3	0	2	3	N	N	N	0	1	3
9	0	2	4	0	3	4	N	N	N	0	2	4
10	0	2	4	0	3	4	N	N	N	0	2	4
11	0	3	4	0	3	4	N	N	N	0	1	4
12	0	4	4	0	4	4	3	4	4	0	3	4
13	0	3	4	0	2	4	N	N	N	0	2	4
14	0	3	4	0	4	4	N	N	N	0	2	4
15	0	4	4	0	4	4	N	N	N	0	2	4
16	0	4	4	0	4	4	N	N	N	0	1	4
17	0	3	4	0	4	4	N	N	N	0	2	4
18	0	2	4	0	4	4	3	4	9	0	1	4
19	0	5	4	0	4	4	N	N	N	0	1	3
20	0	2	4	0	3	4	N	N	N	0	2	4
21	0	3	4	0	4	4	N	N	N	0	2	4
22	0	3	4	0	3	4	N	N	N	0	3	4
23	0	4	4	0	4	4	1	2	4	0	2	3
24	0	1	4	0	3	4	N	N	N	0	2	3
25	0	2	3	0	2	3	N	N	N	0	3	3
26	0	3	3	N	N	N	N	N	N	0	2	4
27	0	2	4	0	3	4	N	N	N	0	1	4
28	0	2	4	0	2	4	N	N	N	0	2	4
29	2	3	4	0	2	4	N	N	N	0	2	4
30	0	3	4	0	2	4	N	N	N	1	2	3
31	0	1	3	0	1	3	N	N	N	0	1	4

SECOND INVERSION

DAY	0000-0600 MST BASE (100M)	0000-0600 MST TOP (100M)	0000-0600 MST TYPE *	0601-1200 MST BASE (100M)	0601-1200 MST TOP (100M)	0601-1200 MST TYPE *	1201-1800 MST BASE (100M)	1201-1800 MST TOP (100M)	1201-1800 MST TYPE *	1801-2400 MST BASE (100M)	1801-2400 MST TOP (100M)	1801-2400 MST TYPE *
1	N	N	N	N	N	N	N	N	N	N	N	N
2	N	N	N	N	N	N	N	N	N	N	N	N
3	N	N	N	N	N	N	N	N	N	N	N	N
4	N	N	N	N	N	N	N	N	N	N	N	N
5	N	N	N	N	N	N	N	N	N	N	N	N
6	N	N	N	N	N	N	N	N	N	N	N	N
7	N	N	N	N	N	N	N	N	N	N	N	N
8	N	N	N	N	N	N	N	N	N	N	N	N
9	N	N	N	N	N	N	N	N	N	N	N	N
10	N	N	N	N	N	N	N	N	N	N	N	N
11	N	N	N	N	N	N	N	N	N	N	N	N
12	N	N	N	N	N	N	N	N	N	N	N	N
13	N	N	N	N	N	N	N	N	N	N	N	N
14	N	N	N	N	N	N	N	N	N	N	N	N
15	N	N	N	N	N	N	N	N	N	N	N	N
16	N	N	N	N	N	N	N	N	N	N	N	N
17	N	N	N	N	N	N	N	N	N	N	N	N
18	3	4	9	N	N	N	N	N	N	3	4	9
19	N	N	N	N	N	N	N	N	N	N	N	N
20	N	N	N	N	N	N	N	N	N	N	N	N
21	N	N	N	N	N	N	N	N	N	N	N	N
22	N	N	N	N	N	N	N	N	N	N	N	N
23	5	6	9	5	6	5	N	N	N	N	N	N
24	N	N	N	N	N	N	N	N	N	N	N	N
25	N	N	N	N	N	N	N	N	N	N	N	N
26	N	N	N	N	N	N	N	N	N	N	N	N
27	N	N	N	N	N	N	N	N	N	N	N	N
28	N	N	N	N	N	N	N	N	N	N	N	N
29	N	N	N	3	4	4	N	N	N	N	N	N
30	N	N	N	N	N	N	N	N	N	N	N	N
31	N	N	N	N	N	N	N	N	N	N	N	N

NOTE: FOR TYPE 1=FRONTAL, 2=SUBSIDENCE, 3=RADIATION (SPIKED ECHO)
4=RADIATION (LAMINAR ECHO) 9=UNKNOWN
N=NO INVERSION M=MISSING DATA OR UNKNOWN

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF OCTOBER 1977

******* FIRST INVERSION FREQUENCY OF OCCURENCE TABLE *******

THICKNESS (METERS)	SFC	INVERSION BASE HEIGHT (IN METERS) 100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	5	0	1	0	0	0	0	0	0	0	6
101-300	20	0	0	0	0	0	0	0	0	0	20
301-500	5	0	0	0	0	0	0	0	0	0	5
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											0
TOTAL	30	0	1	0	0	0	0	0	0	0	31
---TIME 601-1200 MST											
001-100	1	0	0	0	0	0	0	0	0	0	1
101-300	18	0	0	0	0	0	0	0	0	0	18
301-500	10	0	0	0	0	0	0	0	0	0	10
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											2
TOTAL	29	0	0	0	0	0	0	0	0	0	31
---TIME 1201-1800 MST											
001-100	0	1	0	2	0	0	0	0	0	0	3
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											28
TOTAL	0	1	0	2	0	0	0	0	0	0	31
---TIME 1801-2400 MST											
001-100	9	1	0	0	0	0	0	0	0	0	10
101-300	21	0	0	0	0	0	0	0	0	0	21
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											0
TOTAL	30	1	0	0	0	0	0	0	0	0	31
---------- FREQUENCY SUMMARY FOR FIRST INVERSION ----------											
001-100	15	2	1	2	0	0	0	0	0	0	20
101-300	59	0	0	0	0	0	0	0	0	0	59
301-500	15	0	0	0	0	0	0	0	0	0	15
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											30
TOTAL	89	2	1	2	0	0	0	0	0	0	124

ACOUSTIC RADAR ANALYSIS

OLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF OCTOBER 1977

******* SECOND INVERSION FREQUENCY OF OCCURENCE TABLE ******

THICKNESS (METERS)	INVERSION BASE HEIGHT (IN METERS) SFC	100	200	300	400	500	600	700	800	900	TOTAL
--TIME 0- 600 MST											
001-100	0	0	0	1	0	1	0	0	0	0	2
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
0 INVERSION											29
TOTAL	0	0	0	1	0	1	0	0	0	0	31
--TIME 601-1200 MST											
001-100	0	0	0	1	0	1	0	0	0	0	2
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
0 INVERSION											29
TOTAL	0	0	0	1	0	1	0	0	0	0	31
--TIME 1201-1800 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
0 INVERSION											31
TOTAL	0	0	0	0	0	0	0	0	0	0	31
--TIME 1801-2400 MST											
001-100	0	0	0	1	0	0	0	0	0	0	1
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
0 INVERSION											30
TOTAL	0	0	0	1	0	0	0	0	0	0	31
FREQUENCY SUMMARY FOR SECOND INVERSION											
001-100	0	0	0	3	0	2	0	0	0	0	5
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
0 INVERSION											119
TOTAL	0	0	0	3	0	2	0	0	0	0	124

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF OCTOBER 1977

********* TWO HOUR STABILITY ANALYSIS **********

DAY	HOUR 02	04	06	08	10	12	14	16	18	20	22	24
1	E	E	E	E	D	C	C	C	D	D	E	E
2	E	F	F	E	F	D	C	C	C	D	E	E
3	F	F	F	F	F	D	C	C	C	D	F	F
4	F	F	F	F	F	D	C	C	C	D	E	E
5	F	F	F	E	E	D	E	C	C	D	E	E
6	E	E	E	F	D	C	C	C	C	E	E	D
7	D	E	D	D	D	D	D	C	D	E	F	F
8	E	E	E	E	E	D	C	C	D	D	E	E
9	E	E	E	E	E	D	C	C	C	E	E	E
10	E	F	F	F	F	D	C	C	C	E	F	F
11	F	F	F	F	F	D	C	C	C	D	F	F
12	F	F	F	F	F	D	C	C	E	E	E	E
13	E	E	E	E	E	E	D	D	D	C	E	E
14	E	E	E	F	E	D	B	B	B	D	F	F
15	F	F	F	F	F	D	B	C	C	D	F	F
16	F	E	E	E	E	D	C	C	C	E	F	F
17	F	F	F	F	E	D	C	B	B	D	F	F
18	F	F	F	F	F	D	C	B	B	D	F	F
19	E	E	E	E	E	D	C	C	D	E	E	E
20	F	F	F	F	F	D	C	C	C	E	F	F
21	F	F	F	E	E	D	C	C	D	D	F	F
22	F	F	F	E	E	D	C	C	D	E	F	F
23	F	F	F	E	E	E	D	C	E	E	F	F
24	F	F	F	M	M	M	D	M	D	M	M	M
25	M	M	M	M	M	D	C	D	D	E	E	E
26	E	E	E	E	D	D	C	C	D	F	F	F
27	F	F	F	F	E	D	B	C	D	E	E	E
28	E	E	E	E	D	B	E	C	C	D	E	E
29	D	D	D	D	E	D	C	C	D	E	E	E
30	E	E	E	E	E	D	C	C	D	E	E	E
31	E	E	E	E	D	C	C	C	D	E	E	E

PERCENT FREQUENCY OF OCCURENCE FOR EACH CATEGORY

A= 0.0 % B= 3.2 % C=16.7 % D=19.4 % E=31.5 % F=26.1 %

U= 0.0 % M= 3.2 %

NOTE: U=UNKNOWN M=MISSING DATA
CLOUD COVER CONDITIONS USED FROM NWS STATION AT KALISPELL
WIND DATA USED FROM NWS STATION AT KALISPELL

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY — MONTH OF NOVEMBER 1977

FIRST INVERSION

DAY	0000-0600 MST BASE (100M)	TOP (100M)	TYPE *	0601-1200 MST BASE (100M)	TOP (100M)	TYPE *	1201-1800 MST BASE (100M)	TOP (100M)	TYPE *	1801-2400 MST BASE (100M)	TOP (100M)	TYPE *
1	0	2	4	0	2	3	N	N	N	0	1	3
2	0	2	3	N	N	N	N	N	N	0	2	3
3	0	2	4	0	3	4	N	N	N	0	3	4
4	0	4	4	0	4	4	N	N	N	0	4	4
5	0	5	4	0	4	4	N	N	N	N	N	N
6	0	4	4	0	2	4	N	N	N	0	2	3
7	0	2	3	0	2	3	N	N	N	0	2	4
8	0	2	4	0	2	4	N	N	N	0	1	4
9	0	2	4	N	N	N	1	3	9	1	3	9
10	0	3	4	0	2	4	0	3	4	0	2	4
11	0	5	4	0	5	4	3	5	4	0	1	4
12	0	2	4	0	1	4	N	N	N	0	3	4
13	0	4	4	0	3	4	0	2	3	0	2	4
14	0	2	3	N	N	N	N	N	N	0	2	4
15	0	2	4	0	3	4	0	2	4	0	2	3
16	0	2	4	0	1	4	N	N	N	0	2	4
17	0	2	4	0	2	4	N	N	N	N	N	N
18	M	M	M	M	M	M	M	M	M	M	M	M
19	M	M	M	M	M	M	M	M	M	M	M	M
20	M	M	M	M	M	M	M	M	M	M	M	M
21	M	M	M	M	M	M	M	M	M	0	2	4
22	0	3	4	0	2	3	N	N	N	N	N	N
23	N	N	N	N	N	N	N	N	N	3	4	9
24	3	4	9	0	2	4	0	2	3	0	2	4
25	0	1	4	0	3	4	1	3	9	0	3	4
26	0	3	3	0	3	3	0	2	3	0	2	4
27	0	2	4	0	2	3	0	3	3	0	2	3
28	0	2	3	0	2	4	0	2	3	0	3	3
29	0	4	3	0	3	4	N	N	N	0	2	4
30	0	1	4	0	2	4	N	N	N	0	1	4

SECOND INVERSION

DAY	0000-0600 MST BASE (100M)	TOP (100M)	TYPE *	0601-1200 MST BASE (100M)	TOP (100M)	TYPE *	1201-1800 MST BASE (100M)	TOP (100M)	TYPE *	1801-2400 MST BASE (100M)	TOP (100M)	TYPE *
1	N	N	N	N	N	N	N	N	N	N	N	N
2	N	N	N	N	N	N	N	N	N	N	N	N
3	N	N	N	N	N	N	N	N	N	N	N	N
4	N	N	N	N	N	N	N	N	N	N	N	N
5	N	N	N	N	N	N	N	N	N	N	N	N
6	N	N	N	N	N	N	N	N	N	N	N	N
7	N	N	N	N	N	N	N	N	N	N	N	N
8	N	N	N	N	N	N	N	N	N	N	N	N
9	N	N	N	N	N	N	N	N	N	N	N	N
10	N	N	N	N	N	N	N	N	N	N	N	N
11	N	N	N	N	N	N	N	N	N	3	4	9
12	N	N	N	N	N	N	N	N	N	N	N	N
13	N	N	N	N	N	N	N	N	N	N	N	N
14	N	N	N	N	N	N	N	N	N	N	N	N
15	N	N	N	N	N	N	N	N	N	N	N	N
16	N	N	N	N	N	N	N	N	N	N	N	N
17	N	N	N	N	N	N	N	N	N	N	N	N
18	M	M	M	M	M	M	M	M	M	M	M	M
19	M	M	M	M	M	M	M	M	M	M	M	M
20	M	M	M	M	M	M	M	M	M	M	M	M
21	M	M	M	M	M	M	M	M	M	N	N	N
22	N	N	N	N	N	N	N	N	N	N	N	N
23	N	N	N	N	N	N	N	N	N	N	N	N
24	N	N	N	N	N	N	N	N	N	N	N	N
25	N	N	N	N	N	N	N	N	N	N	N	N
26	N	N	N	N	N	N	N	N	N	N	N	N
27	N	N	N	N	N	N	N	N	N	N	N	N
28	N	N	N	N	N	N	N	N	N	N	N	N
29	N	N	N	N	N	N	N	N	N	N	N	N
30	N	N	N	N	N	N	N	N	N	N	N	N

NOTE: FOR TYPE 1=FRONTAL, 2=SUBSIDENCE, 3=RADIATION (SPIKED ECHO)
4=RADIATION (LAMINAR ECHO) 9=UNKNOWN
N=NO INVERSION M=MISSING DATA OR UNKNOWN

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METECROLCGICAL STUDY MCNTH CF NOVEMEER 1977

******* FIRST INVERSION FREQUENCY OF OCCURENCE TABLE *******

THICKNESS (METERS)	SFC	INVERSION EASE HEIGHT (IN METERS) 100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	2	0	0	1	0	0	0	0	0	0	3
101-300	16	0	0	0	0	0	0	0	0	0	16
301-500	6	0	0	0	0	0	0	0	0	0	6
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											1
TOTAL	24	0	0	1	0	0	0	0	0	0	26
---TIME 601-1200 MST											
001-100	2	0	0	0	0	0	0	0	0	0	2
101-300	17	0	0	0	0	0	0	0	0	0	17
301-500	3	0	0	0	0	0	0	0	0	0	3
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											4
TOTAL	22	0	0	0	0	0	0	0	0	0	26
---TIME 1201-1800 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	7	2	0	1	0	0	0	0	0	0	10
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											16
TOTAL	7	2	0	1	0	0	0	0	0	0	26
---TIME 1801-2400 MST											
001-100	4	0	0	1	0	0	0	0	0	0	5
101-300	17	1	0	0	0	0	0	0	0	0	18
301-500	1	0	0	0	0	0	0	0	0	0	1
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											3
TOTAL	22	1	0	1	0	0	0	0	0	0	27
---------- FREQUENCY SUMMARY FOR FIRST INVERSION ----------											
001-100	8	0	0	2	0	0	0	0	0	0	10
101-300	57	3	0	1	0	0	0	0	0	0	61
301-500	10	0	0	0	0	0	0	0	0	0	10
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											24
TOTAL	75	3	0	3	0	0	0	0	0	0	105

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF NOVEMBER 1977

******* SECOND INVERSION FREQUENCY OF OCCURENCE TABLE ******

THICKNESS (METERS)	SFC	INVERSION BASE HEIGHT (IN METERS) 100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											26
TOTAL	0	0	0	0	0	0	0	0	0	0	26
---TIME 601-1200 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											26
TOTAL	0	0	0	0	0	0	0	0	0	0	26
---TIME 1201-1800 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											26
TOTAL	0	0	0	0	0	0	0	0	0	0	26
---TIME 1801-2400 MST											
001-100	0	0	0	1	0	0	0	0	0	0	1
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											26
TOTAL	0	0	0	1	0	0	0	0	0	0	27
---------- FREQUENCY SUMMARY FOR SECOND INVERSION ----------											
001-100	0	0	0	1	0	0	0	0	0	0	1
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											104
TOTAL	0	0	0	1	0	0	0	0	0	0	105

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METECROLOGICAL STUDY MONTH OF NOVEMEER 1977

********* TWO HOUR STABILITY ANALYSIS **********

DAY	HOUR 02	04	06	08	10	12	14	16	18	20	22	24
1	E	E	E	E	C	C	C	D	E	E	E	E
2	D	D	E	D	D	C	C	D	E	E	E	E
3	F	F	F	F	F	C	C	C	D	F	E	E
4	E	E	E	E	D	C	C	C	D	E	E	E
5	E	E	E	E	D	C	E	B	C	D	E	E
6	E	E	E	F	D	C	C	D	D	E	E	E
7	E	E	E	E	D	D	C	D	E	E	F	F
8	F	F	F	F	E	D	C	C	E	E	E	E
9	E	E	E	C	C	D	C	D	D	C	D	M
10	M	M	M	M	M	M	M	M	C	E	E	E
11	F	F	F	E	E	E	B	C	C	E	E	E
12	E	E	E	E	D	D	C	C	E	E	E	E
13	F	E	E	E	D	D	C	E	E	F	E	E
14	E	E	E	D	D	D	D	C	C	E	F	F
15	F	E	E	E	E	D	C	E	E	E	E	E
16	E	F	F	E	C	D	D	D	E	F	E	E
17	E	E	E	E	C	C	C	D	C	C	D	D
18	M	M	M	M	M	M	M	M	M	M	M	M
19	M	M	M	M	M	M	M	M	M	M	M	M
20	M	M	M	M	M	M	M	M	M	M	M	M
21	M	M	M	M	M	M	M	M	M	F	E	E
22	E	E	E	E	C	C	C	B	D	D	C	D
23	C	D	D	C	C	D	D	D	D	D	C	C
24	C	D	D	E	E	E	E	E	E	E	E	E
25	E	E	E	E	E	C	C	C	D	D	E	C
26	E	E	E	E	E	E	E	E	E	E	E	E
27	E	E	E	E	E	E	E	E	E	E	E	E
28	E	E	E	E	E	E	E	E	E	E	C	E
29	D	C	E	E	D	D	C	C	D	F	F	F
30	E	F	F	E	E	D	D	D	F	E	E	E

PERCENT FREQUENCY OF CCCURENCE FOR EACH CATEGORY

A= 0.0 % B= 1.1 % C= 5.3 % D=26.1 % E=43.9 % F= 8.6 %

U= 0.0 % M=15.0 %

NOTE: U=UNKNOWN M=MISSING DATA
CLOUD COVER CONDITIONS USED FROM NWS STATION AT KALI PELL
WIND DATA USED FROM NWS STATION AT KALISPELL

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY — MONTH OF DECEMBER 1977

FIRST INVERSION

DAY	0000-0600 MST BASE (100M)	0000-0600 MST TOP (100M)	0000-0600 MST TYPE *	0601-1200 MST BASE (100M)	0601-1200 MST TOP (100M)	0601-1200 MST TYPE *	1201-1800 MST BASE (100M)	1201-1800 MST TOP (100M)	1201-1800 MST TYPE *	1801-2400 MST BASE (100M)	1801-2400 MST TOP (100M)	1801-2400 MST TYPE *
1	0	2	4	0	2	4	C	2	4	C	3	4
2	1	3	S	0	2	4	C	4	4	0	3	4
3	J	2	3	0	2	3	N	N	N	0	3	3
4	0	4	3	0	3	4	C	3	4	0	2	4
5	0	3	4	0	3	4	0	3	4	0	2	4
6	N	N	N	M	M	M	N	M	M	0	2	3
7	N	N	N	N	N	N	N	N	N	0	2	3
8	1	3	3	1	3	3	2	3	3	1	2	3
9	0	1	4	0	1	4	N	N	N	N	N	N
10	N	M	M	M	M	M	M	M	M	M	M	M
11	1	2	3	0	2	3	0	2	N	0	3	3
12	0	2	3	0	3	3	0	N	N	0	2	3
13	0	2	3	0	2	3	0	3	3	0	3	3
14	0	3	3	0	2	3	2	3	3	0	3	3
15	0	2	4	0	3	4	C	2	3	0	2	3
16	0	2	3	0	3	3	0	2	3	0	2	4
17	0	3	4	0	4	4	0	2	4	0	2	3
18	0	2	4	M	M	M	N	N	N	0	3	4
19	0	2	4	0	2	4	C	2	4	0	2	4
20	0	2	4	0	4	4	N	N	N	0	3	4
21	0	2	4	0	2	4	0	1	3	N	N	N
22	N	N	N	3	4	S	2	3	9	2	3	S
23	1	2	9	2	3	9	N	N	N	N	N	N
24	0	2	4	0	2	4	N	N	N	0	2	4
25	0	3	4	0	3	4	N	N	N	2	3	4
26	2	3	4	0	3	4	N	N	N	0	2	4
27	0	3	4	0	3	4	N	N	N	0	2	4
28	0	2	4	0	2	4	N	N	N	6	7	9
29	4	6	S	0	3	4	M	M	M	M	M	M
30	M	M	M	M	M	M	M	M	M	M	M	M
31	0	1	3	0	2	4	N	N	N	0	2	4

SECOND INVERSION

DAY	0000-0600 MST BASE (100M)	0000-0600 MST TOP (100M)	0000-0600 MST TYPE *	0601-1200 MST BASE (100M)	0601-1200 MST TOP (100M)	0601-1200 MST TYPE *	1201-1800 MST BASE (100M)	1201-1800 MST TOP (100M)	1201-1800 MST TYPE *	1801-2400 MST BASE (100M)	1801-2400 MST TOP (100M)	1801-2400 MST TYPE *
1	N	N	N	N	N	N	N	N	N	N	N	N
2	N	N	N	3	4	9	N	N	N	N	N	N
3	N	N	N	N	N	N	N	N	N	N	N	N
4	N	N	N	N	N	N	N	N	N	N	N	N
5	N	N	N	N	N	N	N	N	N	N	N	N
6	N	N	N	M	M	M	M	M	M	N	N	N
7	N	N	N	N	N	N	N	N	N	N	N	N
8	N	N	N	N	N	N	N	N	N	N	N	N
9	N	N	N	N	N	N	N	N	N	N	N	N
10	M	M	M	M	M	M	M	M	M	M	M	M
11	N	N	N	N	N	N	N	N	N	N	N	N
12	N	N	N	N	N	N	N	N	N	N	N	N
13	N	N	N	N	N	N	N	N	N	N	N	N
14	N	N	N	N	N	N	N	N	N	3	4	9
15	3	4	4	N	N	N	N	N	N	N	N	N
16	N	N	N	N	N	N	N	N	N	N	N	N
17	N	N	N	N	N	N	N	N	N	4	5	S
18	N	N	N	N	N	N	N	N	N	N	N	N
19	N	N	N	N	N	N	N	N	N	N	N	N
20	N	N	N	N	N	N	N	N	N	N	N	N
21	N	N	N	N	N	N	N	N	N	N	N	N
22	N	N	N	N	N	N	N	N	N	N	N	N
23	N	N	N	N	N	N	N	N	N	N	N	N
24	N	N	N	N	N	N	N	N	N	N	N	N
25	N	N	N	N	N	N	N	N	N	N	N	N
26	N	N	N	N	N	N	N	N	N	N	N	N
27	N	N	N	N	N	N	N	N	N	N	N	N
28	N	N	N	N	N	N	N	N	N	N	N	N
29	N	N	N	N	N	N	N	M	M	M	M	M
30	M	M	M	M	M	M	M	M	M	M	M	M
31	N	N	N	N	N	N	N	N	N	N	N	N

NOTE: FOR TYPE 1=FRONTAL, 2=SUBSIDENCE, 3=RADIATION (SPIKED ECHO)
4=RADIATION (LAMINAR ECHO) 9=UNKNOWN
N=NO INVERSION M=MISSING DATA OR UNKNOWN

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF DECEMBER 1977

******* FIRST INVERSION FREQUENCY OF OCCURENCE TABLE *******

THICKNESS (METERS)	SFC	INVERSION BASE HEIGHT (IN METERS) 100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	2	2	1	0	0	0	0	0	0	0	5
101-300	17	2	0	0	1	0	0	0	0	0	20
301-500	1	0	0	0	0	0	0	0	0	0	1
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											3
TOTAL	20	4	1	0	1	0	0	0	0	0	29
---TIME 601-1200 MST											
001-100	1	0	1	1	0	0	0	0	0	0	3
101-300	20	1	0	0	0	0	0	0	0	0	21
301-500	2	0	0	0	0	0	0	0	0	0	2
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											1
TOTAL	23	1	1	1	0	0	0	0	0	0	27
---TIME 1201-1800 MST											
001-100	1	0	3	0	0	0	0	0	0	0	4
101-300	9	0	0	0	0	0	0	0	0	0	9
301-500	1	0	0	0	0	0	0	0	0	0	1
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											13
TOTAL	11	0	3	0	0	0	0	0	0	0	27
---TIME 1801-2400 MST											
001-100	0	1	3	0	0	0	1	0	0	0	5
101-300	20	0	0	0	0	0	0	0	0	0	20
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											3
TOTAL	20	1	3	0	0	0	1	0	0	0	28
---------- FREQUENCY SUMMARY FOR FIRST INVERSION ----------											
001-100	4	3	8	1	0	0	1	0	0	0	17
101-300	66	3	0	0	1	0	0	0	0	0	70
301-500	4	0	0	0	0	0	0	0	0	0	4
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											20
TOTAL	74	6	8	1	1	0	1	0	0	0	111

ACOUSTIC RADAR ANALYSIS

LUMBIA FALLS METEOROLOGICAL STUDY MONTH OF DECEMBER 1977

******* SECOND INVERSION FREQUENCY OF OCCURENCE TABLE ******

ICKNESS METERS)	SFC	INVERSION BASE HEIGHT (IN METERS) 100	200	300	400	500	600	700	800	900	TOTAL
-TIME 0- 600 MST											
001-100	0	0	0	1	0	0	0	0	0	0	1
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
) INVERSION											28
TOTAL	0	0	0	1	0	0	0	0	0	0	29
--TIME 601-1200 MST											
001-100	0	0	0	1	0	0	0	0	0	0	1
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
) INVERSION											26
TOTAL	0	0	0	1	0	0	0	0	0	0	27
--TIME 1201-1800 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
) INVERSION											27
TOTAL	0	0	0	0	0	0	0	0	0	0	27
--TIME 1801-2400 MST											
001-100	0	0	0	1	1	0	0	0	0	0	2
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
) INVERSION											26
TOTAL	0	0	0	1	1	0	0	0	0	0	28
---------- FREQUENCY SUMMARY FOR SECOND INVERSION ----------											
001-100	0	0	0	3	1	0	0	0	0	0	4
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
) INVERSION											107
TOTAL	0	0	0	3	1	0	0	0	0	0	111

ACCUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF DECEMBER 1977

********** TWO HOUR STABILITY ANALYSIS **********

DAY	HOUR 02	04	06	08	10	12	14	16	18	20	22	24
1	E	E	E	E	D	D	C	C	C	D	E	D
2	C	C	D	D	C	D	E	C	E	D	E	E
3	E	E	E	E	E	D	C	C	E	E	E	E
4	D	E	E	C	C	E	M	M	M	M	M	M
5	M	M	M	M	M	M	M	M	M	E	E	D
6	D	D	M	M	M	M	M	M	M	C	C	D
7	D	C	D	D	D	D	C	C	E	F	E	E
8	D	D	D	C	D	D	C	C	C	C	D	E
9	E	E	E	E	D	D	D	D	D	C	C	C
10	M	M	M	M	M	M	M	M	M	M	M	M
11	D	E	E	E	E	E	D	E	E	E	E	E
12	E	E	E	E	C	C	C	C	E	E	E	E
13	E	E	D	C	C	C	C	D	C	D	E	C
14	D	E	E	E	E	E	D	D	D	E	E	E
15	E	E	E	E	E	C	C	D	E	E	E	E
16	E	E	E	D	C	D	D	E	E	E	F	C
17	F	F	F	E	E	E	E	E	E	D	E	E
18	C	C	C	D	M	M	B	E	D	E	E	E
19	E	F	F	E	F	F	E	E	E	E	E	E
20	E	E	E	E	E	E	C	B	D	E	E	E
21	E	F	F	E	E	E	C	C	E	C	C	D
22	D	C	C	C	E	E	E	E	D	C	D	D
23	E	C	D	D	C	D	D	C	C	C	C	D
24	E	E	E	E	E	E	E	C	C	D	E	E
25	E	E	E	E	E	D	B	C	E	E	E	E
26	E	E	E	E	F	F	D	D	C	E	E	E
27	E	E	E	E	E	E	D	D	D	E	E	E
28	E	E	E	E	E	E	D	B	D	C	E	E
29	E	E	E	C	C	E	M	M	M	M	M	M
30	M	M	M	M	M	M	M	M	M	M	M	M
31	E	E	E	E	F	F	C	C	C	F	F	F

PERCENT FREQUENCY OF OCCURENCE FOR EACH CATEGORY

A= 0.0 % B= 1.1 % C= 1.1 % D=34.4 % E=44.1 % F= 4.8 %

U= 0.0 % M=14.5 %

NOTE: U=UNKNOWN M=MISSING DATA
CLOUD COVER CONDITIONS USED FROM NWS STATION AT KALISPELL
WIND DATA USED FROM NWS STATION AT KALISPELL

ACOUSTIC SODAR ANALYSIS

OLUMBIA FALLS METEOROLOGICAL STUDY — MONTH OF JANUARY 1978

FIRST INVERSION

DAY	0000-0600 MST BASE (100M)	TOP (100M)	TYPE *	0601-1200 MST BASE (100M)	TOP (100M)	TYPE *	1201-1800 MST BASE (100M)	TOP (100M)	TYPE *	1801-2400 MST BASE (100M)	TOP (100M)	TYPE *
1	M	M	M	M	M	M	M	M	M	M	M	M
2	M	M	M	M	M	M	M	M	M	M	M	M
3	M	M	M	M	M	M	M	M	M	M	M	M
4	N	M	M	M	M	M	N	M	M	M	M	M
5	C	3	+	0	N	3	C	N	3	0	0	3
6	C	3	+	0	N	3	C	N	3	0	0	3
7	C	2	+	0	N	2	C	N	3	0	0	2
8	3	4	9	3	4	9	4	4	4	0	0	5
9	0	3	4	0	3	4	3	4	4	0	0	3
10	0	3	4	0	3	4	3	4	4	0	0	4
11	0	4	+	0	3	4	3	4	4	0	0	4
12	0	4	+	0	3	4	3	4	4	0	0	4
13	0	3	4	0	3	4	3	4	4	0	0	4
14	0	3	4	0	3	4	3	4	4	0	0	3
15	N	N	4	N	3	4	N	3	4	0	0	3
16	N	2	3	N	3	4	N	3	4	0	0	3
17	N	3	3	N	2	4	N	4	4	0	0	4
18	0	3	4	0	2	4	N	4	4	N	N	4
19	0	2	4	0	2	4	N	4	4	N	N	3
20	0	1	4	0	2	4	N	4	4	N	N	3
21	3	2	4	0	3	4	3	4	4	0	0	3
22	0	2	4	0	2	4	3	4	4	0	0	3
23	0	2	4	0	2	4	3	4	4	0	0	3
24	0	3	4	0	2	4	3	4	4	0	0	3
25	3	4	+	1	2	4	3	4	4	0	0	3
26	0	3	+	0	3	4	3	4	4	0	0	3
27	0	3	+	0	3	4	3	4	4	0	0	3
28	0	3	3	0	3	4	3	4	4	0	0	4
29	0	4	4	0	2	4	3	4	4	0	0	4
30	0	3	4	0	2	4	3	4	4	0	0	4
31	0	3	3	2	3	3	2	3	3	1	2	2

SECOND INVERSION

DAY	0000-0600 MST BASE (100M)	TOP (100M)	TYPE *	0601-1200 MST BASE (100M)	TOP (100M)	TYPE *	1201-1800 MST BASE (100M)	TOP (100M)	TYPE *	1801-2400 MST BASE (100M)	TOP (100M)	TYPE *
1	M	M	M	M	M	M	N	N	N	M	M	N
2	M	M	M	M	M	M	N	N	N	M	M	N
3	M	M	M	M	M	M	N	N	N	M	M	N
4	M	M	M	M	M	M	N	N	N	M	M	N
5	N	N	N	N	N	N	N	N	N	N	N	N
6	N	N	N	N	N	N	N	N	N	N	N	N
7	N	N	N	N	N	N	N	N	N	N	N	N
8	N	N	N	N	N	N	N	N	N	N	N	N
9	N	N	N	N	N	N	N	N	N	N	N	N
10	N	N	N	N	N	N	N	N	N	N	N	N
11	N	N	N	N	N	N	N	N	N	N	N	N
12	N	N	N	N	N	N	N	N	N	N	N	N
13	N	N	N	N	N	N	N	N	N	N	N	N
14	N	N	N	N	N	N	N	N	N	N	N	N
15	N	N	N	N	N	N	N	N	N	N	N	N
16	N	N	N	N	N	N	N	N	N	N	N	N
17	N	N	N	N	N	N	N	N	N	N	N	N
18	N	N	N	N	N	N	N	N	N	N	N	N
19	N	N	N	N	N	N	N	N	N	N	N	N
20	N	N	N	N	N	N	N	N	N	N	N	N
21	N	N	N	N	N	N	N	N	N	N	N	N
22	3	4	N	N	N	N	N	N	N	N	N	N
23	N	N	N	N	N	N	N	N	N	N	N	N
24	N	N	N	N	N	N	N	N	N	N	N	N
25	N	N	N	N	N	N	N	N	N	N	N	N
26	N	N	N	N	N	N	N	N	N	N	N	N
27	N	N	N	N	N	N	N	N	N	N	N	N
28	N	N	N	N	N	N	N	N	N	N	N	N
29	N	N	N	N	N	N	N	N	N	N	N	N
30	N	N	N	N	N	N	N	N	N	3	4	N
31	N	N	N	N	N	N	N	N	N	N	N	N

NOTE: FOR TYPE 1=FRONTAL, 2=SUBSIDENCE, 3=RADIATION (SPIKED ECHO)
4=RADIATION (LAMINAR ECHO) 9=UNKNOWN
N=NO INVERSION M=MISSING DATA OR UNKNOWN

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF JANUARY 1978

******* FIRST INVERSION FREQUENCY OF OCCURENCE TABLE *******

THICKNESS (METERS)	SFC	INVERSION BASE HEIGHT (IN METERS) 100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	1	0	0	3	0	0	0	0	0	0	4
101-300	16	0	0	0	0	0	0	0	0	0	16
301-500	5	0	0	0	0	0	0	0	0	0	5
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											2
TOTAL	22	0	0	3	0	0	0	0	0	0	27
---TIME 601-1200 MST											
001-100	0	1	2	2	0	0	0	0	0	0	5
101-300	16	0	0	0	0	0	0	0	0	0	16
301-500	2	0	0	0	0	0	0	0	0	0	2
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											4
TOTAL	18	1	2	2	0	0	0	0	0	0	27
---TIME 1201-1800 MST											
001-100	1	0	3	2	0	0	0	0	0	0	6
101-300	13	0	0	0	0	0	0	0	0	0	13
301-500	2	0	0	0	0	0	0	0	0	0	2
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											7
TOTAL	16	0	3	2	0	0	0	0	0	0	28
---TIME 1801-2400 MST											
001-100	0	1	1	2	0	0	0	0	0	0	4
101-300	14	0	0	0	0	0	0	0	0	0	14
301-500	6	0	0	0	0	0	0	0	0	0	8
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											2
TOTAL	22	1	1	2	0	0	0	0	0	0	28
---------- FREQUENCY SUMMARY FOR FIRST INVERSION ----------											
001-100	2	2	6	9	0	0	0	0	0	0	19
101-300	59	0	0	0	0	0	0	0	0	0	59
301-500	17	0	0	0	0	0	0	0	0	0	17
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											15
TOTAL	78	2	6	9	0	0	0	0	0	0	110

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF JANUARY 1978

****** SECOND INVERSION FREQUENCY OF OCCURENCE TABLE ******

THICKNESS (METERS)	INVERSION BASE HEIGHT (IN METERS) SFC	100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	0	0	0	1	0	1	0	0	0	0	2
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											25
TOTAL	0	0	0	1	0	1	0	0	0	0	27
---TIME 601-1200 MST											
001-100	0	0	0	0	1	0	0	0	0	0	1
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											26
TOTAL	0	0	0	0	1	0	0	0	0	0	27
---TIME 1201-1800 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											28
TOTAL	0	0	0	0	0	0	0	0	0	0	28
---TIME 1801-2400 MST											
001-100	0	0	0	1	0	1	0	0	0	0	2
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											26
TOTAL	0	0	0	1	0	1	0	0	0	0	28
---------- FREQUENCY SUMMARY FOR SECOND INVERSION ----------											
001-100	0	0	0	2	1	2	0	0	0	0	5
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											105
TOTAL	0	0	0	2	1	2	0	0	0	0	110

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF JANUARY 1978

********* TWO HOUR STABILITY ANALYSIS **********

DAY	HOUR 02	04	06	08	10	12	14	16	18	20	22	24
1	M	M	M	M	M	M	M	M	M	M	M	M
2	M	M	M	M	M	M	M	M	M	M	M	M
3	M	M	M	M	M	M	M	M	M	M	M	M
4	M	M	M	M	M	M	E	E	E	E	E	E
5	E	E	E	E	E	E	D	E	E	E	E	E
6	E	E	D	E	D	C	C	E	E	E	E	E
7	E	E	E	E	E	D	D	D	D	E	E	D
8	D	D	D	D	D	D	D	D	D	D	D	E
9	D	E	E	D	E	E	E	E	E	E	E	E
10	F	F	F	F	F	F	F	F	F	F	F	F
11	F	E	E	E	E	E	D	D	E	E	E	E
12	E	E	E	E	E	E	E	E	E	E	E	E
13	E	E	E	E	E	E	E	E	E	E	E	E
14	D	D	D	D	D	D	D	D	E	E	E	D
15	D	D	D	D	D	C	C	C	D	E	E	E
16	E	E	E	E	E	D	D	D	D	D	D	D
17	D	D	D	D	D	D	D	D	E	D	D	E
18	D	E	E	E	E	D	D	D	E	E	E	E
19	F	F	F	E	E	E	E	D	D	D	D	E
20	E	E	D	D	D	D	D	D	D	D	D	D
21	D	D	D	D	D	E	E	D	D	D	D	E
22	E	E	E	E	E	D	C	D	E	E	E	E
23	E	E	E	F	E	D	C	D	E	E	E	E
24	E	E	E	E	E	E	E	E	E	E	E	E
25	E	E	E	D	D	D	D	D	D	D	D	D
26	D	D	D	D	D	D	D	E	E	E	E	E
27	E	D	D	D	D	E	E	E	E	E	E	E
28	E	E	E	E	E	E	E	E	E	E	E	E
29	D	E	E	D	D	D	D	D	D	E	E	E
30	E	E	E	E	E	D	D	E	E	E	E	E
31	D	D	D	D	D	D	D	D	D	D	D	D

PERCENT FREQUENCY OF OCCURENCE FOR EACH CATEGORY

A= 0.0 % B= 0.0 % C= 1.9 % D=34.1 % E=48.1 % F= 4.6 %

U= 0.0 % M=11.3 %

NOTE: U=UNKNOWN M=MISSING DATA
CLOUD COVER CONDITIONS USED FROM NWS STATION AT KALISPELL
WIND DATA USED FROM NWS STATION AT KALISPELL

ACOUSTIC RADAR ANALYSIS

UMBIA FALLS METEOROLOGICAL STUDY MONTH OF FEBUARY 1978

**********FIRST INVERSION**********

0000-0600 MST			0601-1200 MST			1201-1800 MST			1801-2400 MST		
BASE (100M)	TOP (100M)	TYPE *	BASE (100M)	TOP (100M)	TYPE *	BASE (100M)	TOP (100M)	TYPE *	BASE (100M)	TOP (100M)	TYPE *
0	3	3	0	3	3	N	N	N	N	N	N
N	N	N	3	4	9	3	4	5	2	3	4
C	3	3	0	3	3	N	N	N	0	2	3
C	2	4	0	4	4	C	N	4	0	5	4
0	5	4	0	5	4	C	N	4	0	6	4
0	5	4	3	4	9	C	N	N	0	3	4
0	5	4	0	5	4	C	N	4	0	2	3	9
0	2	4	0	3	4	N	N	N	N	0	2	4
0	4	4	0	5	4	N	N	N	N	0	N	4
3	4	9	4	5	9	N	N	N	N	0	4	3
3	4	9	0	2	3	N	N	N	N	0	0	2	3
0	2	4	0	2	4	N	N	N	N	0	0	3	4
0	3	4	0	3	4	N	C	N	N	0	0	2	4
C	2	4	0	4	4	C	0	2	4	N	0	N	N	4
3	4	9	0	4	4	C	0	3	4	4	0	3	4
0	3	4	0	4	4	C	C	4	4	1	0	2	3
0	4	4	0	2	4	N	N	N	4	N	1	0	2	3	4
0	2	3	0	3	4	N	N	N	4	N	1	0	0	3	4
0	4	4	0	4	4	C	N	3	4	N	1	0	0	1	4
C	2	4	0	2	4	N	C	N	4	4	0	0	0	3	4
C	5	4	0	5	4	C	2	3	4	4	0	0	0	3	4
C	4	4	0	4	4	C	2	0	3	4	4	0	0	3	4
C	6	4	0	5	4	C	2	0	4	4	4	0	0	2	4
0	2	3	0	2	4	N	N	N	4	N	N	0	0	2	4
0	3	3	0	3	3	N	N	N	N	N	N	0	N	N	N
C	4	4	0	4	4	N	C	N	4	N	4	0	0	3	4
0	5	4	0	4	4	C	2	3	4	0	2	3
0	3	3	0	3	3	2	3	3	0	1	3

**********SECOND INVERSION**********

0000-0600 MST			0601-1200 MST			1201-1800 MST			1801-2400 MST		
BASE (100M)	TOP (100M)	TYPE *	BASE (100M)	TOP (100M)	TYPE *	BASE (100M)	TOP (100M)	TYPE *	BASE (100M)	TOP (100M)	TYPE *
N	N	N	N	N	N	N	N	N	N	N	N
N	N	N	N	N	N	4	5	9	4	5	9
N	N	N	N	N	N	N	N	N	N	N	N
N	N	N	N	N	N	N	N	N	N	N	N
N	N	N	N	N	N	N	N	N	N	N	N
N	N	N	N	N	N	N	N	N	N	N	N
3	4	9	N	N	N	N	N	N	N	N	N
N	N	N	N	N	N	N	N	N	N	N	N
N	N	N	N	N	N	N	N	N	N	N	N
N	N	N	N	N	N	N	N	N	N	N	N
N	N	N	N	N	N	N	N	N	N	N	N
N	N	N	N	N	N	N	N	N	N	N	N
N	N	N	N	N	N	N	N	N	N	N	N
N	N	N	N	N	N	N	N	N	N	N	N
N	N	N	N	N	N	N	N	N	N	N	N
N	N	N	N	N	N	N	N	N	N	N	N
N	N	N	N	N	N	N	N	N	N	N	N
N	N	N	N	N	N	N	N	N	N	N	N
N	N	N	N	N	N	N	N	N	N	N	N
N	N	N	N	N	N	N	N	N	4	5	9
N	N	N	N	N	N	N	N	N	3	N	N
N	N	N	N	N	N	N	N	N	N	N	N
N	N	N	N	N	N	N	N	N	N	N	N
N	N	N	N	N	N	N	N	N	N	N	N
N	N	N	N	N	N	N	N	N	N	N	N
N	N	N	N	N	N	N	N	N	N	N	N
N	N	N	N	N	N	N	N	N	N	N	N
N	N	N	N	N	N	N	N	N	N	N	N
N	N	N	N	N	N	N	N	N	1	3	3

NOTE: FOR TYPE 1=FRONTAL,2=SUBSIDENCE,3=RADIATION (SPIKED ECHO)
4=RADIATION (LAMINAR ECHO) 9=UNKNOWN
N=NO INVERSION M=MISSING DATA OR UNKNOWN

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF FEBUARY 1978

******* FIRST INVERSION FREQUENCY OF OCCURENCE TABLE *******

THICKNESS (METERS)	SFC	INVERSION BASE HEIGHT (IN METERS) 100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	0	0	0	3	0	0	0	0	0	0	3
101-300	13	0	0	0	0	0	0	0	0	0	13
301-500	10	0	0	0	0	0	0	0	0	0	10
501-900	1	0	0	0	0	0	0	0	0	0	1
NO INVERSION											1
TOTAL	24	0	0	3	0	0	0	0	0	0	28
---TIME 601-1200 MST											
001-100	0	0	0	2	1	0	0	0	0	0	3
101-300	12	0	0	0	0	0	0	0	0	0	12
301-500	13	0	0	0	0	0	0	0	0	0	13
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											0
TOTAL	25	0	0	2	1	0	0	0	0	0	28
---TIME 1201-1800 MST											
001-100	0	0	2	1	0	0	0	0	0	0	3
101-300	5	0	0	0	0	0	0	0	0	0	5
301-500	5	0	0	0	0	0	0	0	0	0	5
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											15
TOTAL	10	0	2	1	0	0	0	0	0	0	28
---TIME 1801-2400 MST											
001-100	2	1	2	0	0	0	0	0	0	0	5
101-300	16	0	0	0	0	0	0	0	0	0	16
301-500	2	0	0	0	0	0	0	0	0	0	2
501-900	1	0	0	0	0	0	0	0	0	0	1
NO INVERSION											4
TOTAL	21	1	2	0	0	0	0	0	0	0	28
---------- FREQUENCY SUMMARY FOR FIRST INVERSION ----------											
001-100	2	1	4	6	1	0	0	0	0	0	14
101-300	46	0	0	0	0	0	0	0	0	0	46
301-500	30	0	0	0	0	0	0	0	0	0	30
501-900	2	0	0	0	0	0	0	0	0	0	2
NO INVERSION											20
TOTAL	80	1	4	6	1	0	0	0	0	0	112

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF FEBUARY 1978

******* SECOND INVERSION FREQUENCY OF OCCURENCE TABLE ******

THICKNESS (METERS)	INVERSION BASE HEIGHT (IN METERS) SFC	100	200	300	400	500	600	700	800	900	TOTAL
--TIME 0- 600 MST											
001-100	0	0	0	1	0	0	0	0	0	0	1
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
0 INVERSION											27
TOTAL	0	0	0	1	0	0	0	0	0	0	28
--TIME 601-1200 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
0 INVERSION											28
TOTAL	0	0	0	0	0	0	0	0	0	0	28
--TIME 1201-1800 MST											
001-100	0	0	0	0	1	0	0	0	0	0	1
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
0 INVERSION											27
TOTAL	0	0	0	0	1	0	0	0	0	0	28
--TIME 1801-2400 MST											
001-100	0	0	0	1	2	0	0	0	0	0	3
101-300	0	1	0	0	0	0	0	0	0	0	1
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
0 INVERSION											24
TOTAL	0	1	0	1	2	0	0	0	0	0	28
---------- FREQUENCY SUMMARY FOR SECOND INVERSION ----------											
001-100	0	0	0	2	3	0	0	0	0	0	5
101-300	0	1	0	0	0	0	0	0	0	0	1
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
0 INVERSION											106
TOTAL	0	1	0	2	3	0	0	0	0	0	112

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF FEBUARY 1978

********* TWO HOUR STABILITY ANALYSIS **********

	HOUR											
DAY	02	04	06	08	10	12	14	16	18	20	22	24
1	D	E	E	D	D	D	D	C	C	C	C	D
2	D	C	D	D	D	D	D	C	C	C	C	D
3	D	E	E	E	D	C	C	C	E	E	E	E
4	E	E	E	E	E	E	E	E	C	C	E	E
5	E	E	E	E	E	E	E	C	E	E	E	E
6	E	E	E	D	D	C	C	C	E	E	E	E
7	E	E	E	E	E	E	E	E	E	E	C	D
8	E	E	E	E	E	D	C	C	C	E	F	F
9	E	F	F	E	E	D	C	C	C	C	C	D
10	C	D	D	D	D	C	C	C	E	E	E	E
11	E	E	E	E	E	D	C	C	C	E	E	E
12	E	E	E	E	D	B	B	C	C	E	E	E
13	E	E	E	E	E	E	D	C	C	F	F	F
14	F	F	F	E	E	E	C	C	C	C	C	D
15	D	E	E	E	D	E	C	C	E	E	E	E
16	E	E	E	E	E	E	E	E	C	C	C	E
17	E	E	E	E	D	C	C	C	E	E	E	E
18	E	E	E	E	E	E	D	C	C	E	E	E
19	E	E	E	E	E	E	E	E	C	C	E	E
20	E	E	E	E	E	E	E	C	C	C	F	F
21	F	E	E	E	E	E	E	E	E	E	F	F
22	E	E	E	E	F	F	E	C	B	C	F	F
23	E	E	E	E	E	E	E	E	E	E	E	E
24	E	E	E	E	D	D	C	C	C	E	E	E
25	E	E	E	E	D	C	C	C	C	C	C	C
26	C	E	E	E	C	C	B	C	C	C	E	E
27	E	E	E	E	E	E	E	E	E	E	E	E
28	D	D	D	D	D	E	D	C	E	E	C	C

PERCENT FREQUENCY OF OCCURENCE FOR EACH CATEGORY

A= 0.0 % B= 1.2 % C= 6.8 % D=28.9 % E=57.4 % F= 5.7 %

U= 0.0 % M= 0.0 %

NOTE: U=UNKNOWN M=MISSING DATA
CLOUD COVER CONDITIONS USED FROM NWS STATION AT KALISPELL
WIND DATA USED FROM NWS STATION AT KALISPELL

ACOUSTIC RADAR ANALYSIS

LUMBIA FALLS METEOROLOGICAL STUDY MONTH OF MARCH 1978

**********FIRST INVERSION**********

Y	0000-0600 MST BASE (100M)	TOP (100M)	TYPE *	0601-1200 MST BASE (100M)	TOP (100M)	TYPE *	1201-1800 MST BASE (100M)	TOP (100M)	TYPE *	1801-2400 MST BASE (100M)	TOP (100M)	TYPE *
	2	3	3	1	2	3	N	N	N	0	3	3
	C	3	3	1	2	3	N	N	N	0	2	3
	C	2	3	0	2	4	C	1	4	C	1	4
	C	1	4	N	N	N	N	N	N	0	2	4
	C	5	4	0	5	4	N	N	N	N	N	N
	C	1	4	3	4	9	C	2	4	C	2	4
	C	5	4	C	4	4	1	2	4	0	4	4
	0	4	4	0	2	4	0	2	4	C	3	4
	0	2	4	2	3	9	2	3	9	C	2	4
	0	5	4	0	3	4	N	N	N	0	3	4
	0	4	4	0	3	4	N	N	N	N	N	N
	C	2	4	0	3	4	N	N	N	0	4	4
	C	2	3	0	2	3	N	N	N	0	2	3
	0	2	4	0	3	4	N	N	N	0	2	4
	C	2	4	0	2	4	N	N	N	0	2	4
	0	3	4	2	3	4	N	N	N	0	2	4
	C	5	4	0	4	4	C	2	4	0	2	3
	C	2	3	0	2	4	N	N	N	0	3	4
	0	4	4	0	5	4	C	2	3	0	2	3
	0	2	4	0	2	4	N	N	N	0	2	4
	C	2	4	0	3	4	N	N	N	0	3	4
	C	5	3	3	4	3	N	N	N	2	3	3
	C	3	4	N	N	N	N	N	N	0	1	3
	C	3	3	1	3	3	N	N	N	0	1	4
	0	2	4	0	2	4	N	N	N	0	3	3
	0	2	4	0	3	4	N	N	N	0	2	4
	0	2	4	0	2	4	N	N	N	0	1	4
	0	2	4	0	2	4	N	N	N	0	2	4
	C	5	4	0	4	4	N	N	N	0	3	4
	0	2	4	0	3	4	2	3	4	0	2	4
	C	1	4	N	N	N	N	N	N	0	2	4

**********SECOND INVERSION**********

Y	0000-0600 MST BASE (100M)	TOP (100M)	TYPE *	0601-1200 MST BASE (100M)	TOP (100M)	TYPE *	1201-1800 MST BASE (100M)	TOP (100M)	TYPE *	1801-2400 MST BASE (100M)	TOP (100M)	TYPE *
	N	N	N	N	N	N	N	N	N	N	N	N
	N	N	N	N	N	N	N	N	N	N	N	N
	N	N	N	N	N	N	N	N	N	N	N	N
	N	N	N	N	N	N	N	N	N	N	N	N
	N	N	N	N	N	N	N	N	N	N	N	N
	4	6	9	N	N	N	N	N	N	N	N	N
	N	N	N	N	N	N	N	N	N	N	N	N
	N	N	N	N	N	N	N	N	N	N	N	N
	N	N	N	N	N	N	N	N	N	N	N	N
	N	N	N

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF MARCH 1978

******* FIRST INVERSION FREQUENCY OF OCCURENCE TABLE *******

THICKNESS (METERS)	INVERSION BASE HEIGHT (IN METERS) SFC	100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	3	0	1	0	0	0	0	0	0	0	4
101-300	19	0	0	0	0	0	0	0	0	0	19
301-500	8	0	0	0	0	0	0	0	0	0	8
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											0
TOTAL	30	0	1	0	0	0	0	0	0	0	31
---TIME 601-1200 MST											
001-100	0	2	2	2	0	0	0	0	0	0	6
101-300	16	1	0	0	0	0	0	0	0	0	17
301-500	5	0	0	0	0	0	0	0	0	0	5
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											3
TOTAL	21	3	2	2	0	0	0	0	0	0	31
---TIME 1201-1800 MST											
001-100	1	1	2	0	0	0	0	0	0	0	4
101-300	4	0	0	0	0	0	0	0	0	0	4
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											23
TOTAL	5	1	2	0	0	0	0	0	0	0	31
---TIME 1801-2400 MST											
001-100	4	0	1	0	0	0	0	0	0	0	5
101-300	22	0	0	0	0	0	0	0	0	0	22
301-500	2	0	0	0	0	0	0	0	0	0	2
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											2
TOTAL	28	0	1	0	0	0	0	0	0	0	31
---------- FREQUENCY SUMMARY FOR FIRST INVERSION ----------											
001-100	8	3	6	2	0	0	0	0	0	0	19
101-300	61	1	0	0	0	0	0	0	0	0	62
301-500	15	0	0	0	0	0	0	0	0	0	15
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											28
TOTAL	84	4	6	2	0	0	0	0	0	0	124

ACOUSTIC RADAR ANALYSIS

OLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF MARCH 1978

******* SECOND INVERSION FREQUENCY OF OCCURENCE TABLE ******

THICKNESS (METERS)	SFC	INVERSION BASE HEIGHT (IN METERS) 100	200	300	400	500	600	700	800	900	TOTAL
--TIME 0- 600 MST											
001-100	0	0	0	1	0	0	0	0	0	0	1
101-300	0	0	0	0	1	0	0	0	0	0	1
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
0 INVERSION											29
TOTAL	0	0	0	1	1	0	0	0	0	0	31
--TIME 601-1200 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
0 INVERSION											31
TOTAL	0	0	0	0	0	0	0	0	0	0	31
--TIME 1201-1800 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
0 INVERSION											31
TOTAL	0	0	0	0	0	0	0	0	0	0	31
--TIME 1801-2400 MST											
001-100	0	0	0	1	1	0	0	0	0	0	2
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
0 INVERSION											29
TOTAL	0	0	0	1	1	0	0	0	0	0	31
---------- FREQUENCY SUMMARY FOR SECOND INVERSION ----------											
001-100	0	0	0	2	1	0	0	0	0	0	3
101-300	0	0	0	0	1	0	0	0	0	0	1
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
0 INVERSION											120
TOTAL	0	0	0	2	2	0	0	0	0	0	124

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF MARCH 1978

********* TWO HOUR STABILITY ANALYSIS **********

DAY	HOUR 02	04	06	08	10	12	14	16	18	20	22	24
1	D	D	D	D	C	C	C	C	D	E	E	E
2	E	E	E	E	D	C	C	C	C	E	E	E
3	E	E	E	E	F	F	E	E	E	E	E	E
4	E	E	D	D	D	B	E	E	E	E	E	E
5	E	E	E	E	D	D	D	D	D	D	D	E
6	D	D	D	D	B	B	B	E	E	E	E	E
7	F	E	E	E	E	D	D	D	D	D	E	E
8	E	E	E	E	E	E	E	E	E	E	E	E
9	E	E	E	D	B	B	C	D	E	F	F	F
10	E	E	E	E	E	D	C	C	E	E	F	F
11	F	F	F	E	E	D	E	D	D	D	D	E
12	E	E	E	E	D	D	D	D	D	D	E	E
13	E	E	E	E	D	D	D	D	D	E	E	E
14	E	D	D	D	C	C	C	C	D	F	F	F
15	F	E	E	F	D	C	C	C	E	E	F	F
16	E	E	E	D	D	D	B	E	E	F	E	E
17	E	E	E	E	E	E	E	E	E	E	E	E
18	E	E	E	E	E	E	D	C	D	F	F	F
19	F	F	F	E	E	E	E	D	D	D	F	F
20	F	E	E	E	D	C	C	C	E	E	F	F
21	F	F	F	E	E	D	C	C	C	E	E	E
22	E	E	E	D	C	C	C	C	D	E	E	E
23	E	E	E	D	C	C	C	C	D	E	D	D
24	E	E	E	D	C	C	C	C	D	E	E	E
25	E	E	E	D	C	C	C	C	E	E	E	E
26	F	E	E	E	D	C	C	C	D	F	F	F
27	F	F	F	E	D	B	C	C	D	E	E	E
28	E	E	E	D	B	B	B	D	C	D	F	F
29	F	F	F	D	C	C	B	C	C	D	F	F
30	E	D	E	E	E	D	D	D	D	E	E	E
31	D	F	F	E	D	C	C	C	C	E	E	E

PERCENT FREQUENCY OF OCCURENCE FOR EACH CATEGORY

A= 0.0 % B= 4.0 % C=14.5 % D=22.8 % E=45.4 % F=13.2 %

U= 0.0 % M= 0.0 %

NOTE: U=UNKNOWN M=MISSING DATA
CLOUD COVER CONDITIONS USED FROM NWS STATION AT KALISPELL
WIND DATA USED FROM NWS STATION AT KALISPELL

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY — MONTH OF APRIL 1978

FIRST INVERSION

DAY	0000-0600 MST BASE (100M)	0000-0600 MST TOP (100M)	0000-0600 MST TYPE *	0601-1200 MST BASE (100M)	0601-1200 MST TOP (100M)	0601-1200 MST TYPE *	1201-1800 MST BASE (100M)	1201-1800 MST TOP (100M)	1201-1800 MST TYPE *	1801-2400 MST BASE (100M)	1801-2400 MST TOP (100M)	1801-2400 MST TYPE *
1	C	3	4	2	5	4	2	3	4	0	2	4
2	C	1	3	1	2	4	2	3	4	0	2	4
3	C	3	4	N	N	N	N	N	N	0	2	4
4	C	4	4	2	5	4	N	N	N	0	2	4
5	C	1	3	N	N	N	N	N	N	0	1	4
6	C	3	4	2	4	4	N	N	N	C	2	3
7	C	3	3	2	3	4	N	N	N	0	1	4
8	C	2	4	N	N	N	N	N	N	0	2	4
9	C	2	4	1	2	4	N	N	N	0	1	4
0	C	2	4	2	4	4	N	N	N	0	2	4
1	C	2	4	N	N	N	N	N	N	0	1	3
2	C	1	4	1	2	4	N	N	N	0	1	4
3	C	3	4	2	3	4	N	N	N	0	2	3
4	C	1	3	C	3	3	2	3	4	C	3	3
5	C	3	3	3	5	3	N	N	N	C	2	4
6	C	2	3	1	2	3	N	N	N	0	2	3
7	M	M	M	M	M	M	N	N	N	0	2	4
8	C	3	4	2	3	4	N	N	N	0	2	3
9	C	2	3	1	2	4	N	N	N	C	1	3
0	C	1	3	C	2	4	N	N	N	C	1	4
1	C	1	4	1	2	4	N	N	N	C	2	3
2	M	M	M	M	M	M	M	M	M	M	M	M
3	M	M	M	M	M	M	M	M	M	M	M	M
4	M	M	M	M	M	M	M	M	M	M	M	M
5	M	M	M	M	M	M	M	M	M	M	M	M
6	M	M	M	M	M	M	M	M	M	M	M	M
7	M	M	M	M	M	M	M	M	M	M	M	M
8	M	M	M	M	M	M	M	M	M	M	M	M
9	M	M	M	M	M	M	M	M	M	M	M	M
0	M	M	M	M	M	M	M	M	M	M	M	M

SECOND INVERSION

DAY	0000-0600 MST BASE (100M)	0000-0600 MST TOP (100M)	0000-0600 MST TYPE *	0601-1200 MST BASE (100M)	0601-1200 MST TOP (100M)	0601-1200 MST TYPE *	1201-1800 MST BASE (100M)	1201-1800 MST TOP (100M)	1201-1800 MST TYPE *	1801-2400 MST BASE (100M)	1801-2400 MST TOP (100M)	1801-2400 MST TYPE *
1	N	N	N	N	N	N	N	N	N	N	N	N
2	N	N	N	N	N	N	N	N	N	N	N	N
3	N	N	N	N	N	N	N	N	N	N	N	N
4	N	N	N	N	N	N	N	N	N	N	N	N
5	N	N	N	N	N	N	N	N	N	N	N	N
6	N	N	N	N	N	N	N	N	N	N	N	N
7	N	N	N	N	N	N	N	N	N	N	N	N
8	N	N	N	N	N	N	N	N	N	N	N	N
9	N	N	N	N	N	N	N	N	N	N	N	N
0	3	4	4	N	N	N	N	N	N	N	N	N
1	N	N	N	N	N	N	N	N	N	N	N	N
2	N	N	N	N	N	N	N	N	N	N	N	N
3	N	N	N	N	N	N	N	N	N	N	N	N
4	N	N	N	N	N	N	N	N	N	N	N	N
5	N	N	N	N	N	N	N	N	N	N	N	N
6	N	N	N	N	N	N	N	N	N	N	N	N
7	M	M	M	M	M	M	N	N	N	N	N	N
8	4	5	4	N	N	N	N	N	N	N	N	N
9	N	N	N	N	N	N	N	N	N	N	N	N
0	N	N	N	N	N	N	N	N	N	N	N	N
1	N	N	N	N	N	N	N	N	N	N	N	N
2	N	M	M	M	M	M	M	M	M	M	M	M
3	M	M	M	M	M	M	M	M	M	M	M	M
4	M	M	M	M	M	M	M	M	M	M	M	M
5	M	M	M	M	M	M	M	M	M	M	M	M
6	M	M	M	M	M	M	M	M	M	M	M	M
7	M	M	M	M	M	M	M	M	M	M	M	M
8	M	M	M	M	M	M	M	M	M	M	M	M
9	M	M	M	M	M	M	M	M	M	M	M	M
0	M	M	M	M	M	M	M	M	M	M	M	M

NOTE: FOR TYPE 1=FRONTAL, 2=SUBSIDENCE, 3=RADIATION (SPIKED ECHO)
4=RADIATION (LAMINAR ECHO) 9=UNKNOWN
N=NO INVERSION M=MISSING DATA OR UNKNOWN

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF APRIL 1978

******* FIRST INVERSION FREQUENCY OF OCCURENCE TABLE *******

THICKNESS (METERS)	INVERSION BASE HEIGHT (IN METERS) SFC	100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	6	0	0	0	0	0	0	0	0	0	6
101-300	12	0	0	0	0	0	0	0	0	0	12
301-500	2	0	0	0	0	0	0	0	0	0	2
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											0
TOTAL	20	0	0	0	0	0	0	0	0	0	20
---TIME 601-1200 MST											
001-100	0	6	3	0	0	0	0	0	0	0	9
101-300	2	0	4	1	0	0	0	0	0	0	7
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											4
TOTAL	2	6	7	1	0	0	0	0	0	0	20
---TIME 1201-1800 MST											
001-100	0	0	3	0	0	0	0	0	0	0	3
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											18
TOTAL	0	0	3	0	0	0	0	0	0	0	21
---TIME 1801-2400 MST											
001-100	7	0	0	0	0	0	0	0	0	0	7
101-300	14	0	0	0	0	0	0	0	0	0	14
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											0
TOTAL	21	0	0	0	0	0	0	0	0	0	21
---------- FREQUENCY SUMMARY FOR FIRST INVERSION ----------											
001-100	13	6	6	0	0	0	0	0	0	0	25
101-300	26	0	4	1	0	0	0	0	0	0	33
301-500	2	0	0	0	0	0	0	0	0	0	2
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											22
TOTAL	43	6	10	1	0	0	0	0	0	0	82

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF APRIL 1978

******* SECOND INVERSION FREQUENCY OF OCCURENCE TABLE ******

THICKNESS (METERS)	INVERSION BASE HEIGHT (IN METERS) SFC	100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	0	0	0	1	1	0	0	0	0	0	2
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											18
TOTAL	0	0	0	1	1	0	0	0	0	0	20
---TIME 601-1200 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											20
TOTAL	0	0	0	0	0	0	0	0	0	0	20
---TIME 1201-1800 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											21
TOTAL	0	0	0	0	0	0	0	0	0	0	21
---TIME 1801-2400 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											21
TOTAL	0	0	0	0	0	0	0	0	0	0	21
---------- FREQUENCY SUMMARY FOR SECOND INVERSION ----------											
001-100	0	0	0	1	1	0	0	0	0	0	2
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											80
TOTAL	0	0	0	1	1	0	0	0	0	0	82

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF APRIL 1978

********* TWO HOUR STABILITY ANALYSIS **********

DAY	HOUR 02	04	06	08	10	12	14	16	18	20	22	24
1	E	D	D	D	E	C	D	C	D	E	D	D
2	D	D	D	D	E	C	D	D	C	C	E	E
3	E	D	E	D	C	C	D	C	C	D	F	F
4	E	E	E	E	D	C	C	C	C	D	E	D
5	D	E	D	D	C	D	D	D	C	D	E	E
6	F	E	E	E	D	C	C	C	C	E	E	E
7	E	E	E	E	C	D	C	C	C	E	F	F
8	F	E	E	D	C	C	C	C	D	E	F	F
9	F	F	F	F	D	C	C	C	C	D	F	F
10	F	F	F	F	D	C	C	C	D	E	E	E
11	E	E	D	D	D	D	C	C	D	F	F	F
12	E	E	E	F	D	C	C	C	C	D	F	F
13	F	F	F	F	D	C	C	B	B	E	E	E
14	E	E	E	E	E	E	D	D	D	E	E	E
15	E	E	E	E	C	D	C	C	C	E	E	D
16	D	E	E	E	D	C	C	D	D	E	D	D
17	M	M	M	M	M	M	D	C	D	D	E	E
18	E	E	E	E	D	C	C	C	C	D	F	F
19	F	F	F	E	D	C	C	C	C	E	E	E
20	E	D	E	D	D	D	C	C	C	D	E	D
21	D	D	D	D	D	D	D	D	E	E	E	E
22	M	M	M	M	M	M	M	M	M	M	M	M
23	M	M	M	M	M	M	M	M	M	M	M	M
24	M	M	M	M	M	M	M	M	M	M	M	M
25	M	M	M	M	M	M	M	M	M	M	M	M
26	M	M	M	M	M	M	M	M	M	M	M	M
27	M	M	M	M	M	M	M	M	M	M	M	M
28	M	M	M	M	M	M	M	M	M	M	M	M
29	M	M	M	M	M	M	M	M	M	M	M	M
30	M	M	M	M	M	M	M	M	M	M	M	M

PERCENT FREQUENCY OF OCCURENCE FOR EACH CATEGORY

A= 0.0 % B= 0.6 % C=16.7 % D=19.4 % E=21.4 % F= 9.2 %

U= 1.1 % M=31.7 %

NOTE: U=UNKNOWN M=MISSING DATA
CLOUD COVER CONDITIONS USED FROM NWS STATION AT KALISPELL
WIND DATA USED FROM NWS STATION AT KALISPELL

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY — MONTH OF MAY — 1978

FIRST INVERSION

DAY	0000-0600 MST BASE (100M)	TOP (100M)	TYPE *	0601-1200 MST BASE (100M)	TOP (100M)	TYPE *	1201-1800 MST BASE (100M)	TOP (100M)	TYPE *	1801-2400 MST BASE (100M)	TOP (100M)	TYPE *
1	M	M	M	M	M	M	M	M	M	M	M	M
2	M	M	M	M	M	M	M	M	M	M	M	M
3	M	M	M	M	M	M	M	M	M	M	M	M
4	M	M	M	M	M	M	M	M	M	M	M	M
5	M	M	M	M	M	M	M	M	M	M	M	M
6	M	M	M	M	M	M	M	M	M	M	M	M
7	M	M	M	M	M	M	M	M	M	M	M	M
8	M	M	M	M	M	M	N	N	N	0	1	4
9	0	1	4	0	1	4	0	2	4	0	2	4
10	0	2	4	N	N	N	N	N	N	N	N	N
11	0	1	4	0	1	4	N	N	N	0	2	4
12	0	3	4	N	N	N	N	N	N	0	2	4
13	0	3	4	3	4	4	3	4	4	0	3	4
14	0	2	4	0	2	4	N	N	N	0	2	4
15	2	3	4	1	2	4	N	N	N	0	1	4
16	0	1	4	N	N	N	N	N	N	0	2	4
17	0	1	4	N	N	N	N	N	N	N	N	N
18	0	4	4	1	4	4	N	N	N	0	1	4
19	0	3	4	1	3	4	N	N	N	N	N	N
20	0	4	4	2	4	4	N	N	N	0	1	4
21	0	4	4	4	5	4	N	N	N	2	4	4
22	0	2	4	N	N	N	N	N	N	0	1	4
23	0	2	4	0	2	4	N	N	N	0	2	4
24	N	N	N	0	1	4	N	N	N	0	1	4
25	0	3	4	1	3	4	N	N	N	0	2	4
26	0	1	4	N	N	N	N	N	N	N	N	N
27	0	1	4	1	2	4	N	N	N	0	1	4
28	M	M	M	M	M	M	M	M	M	M	M	M
29	M	M	M	M	M	M	M	M	M	M	M	M
30	M	M	M	M	M	M	M	M	M	M	M	M
31	M	M	M	M	M	M	M	M	M	M	M	M

SECOND INVERSION

DAY	0000-0600 MST BASE (100M)	TOP (100M)	TYPE *	0601-1200 MST BASE (100M)	TOP (100M)	TYPE *	1201-1800 MST BASE (100M)	TOP (100M)	TYPE *	1801-2400 MST BASE (100M)	TOP (100M)	TYPE *
1	M	M	M	M	M	M	M	M	M	M	M	M
2	M	M	M	M	M	M	M	M	M	M	M	M
3	M	M	M	M	M	M	M	M	M	M	M	M
4	M	M	M	M	M	M	M	M	M	M	M	M
5	M	M	M	M	M	M	M	M	M	M	M	M
6	M	M	M	M	M	M	M	M	M	M	M	M
7	M	M	M	M	M	M	M	M	M	M	M	M
8	M	M	M	M	M	M	N	N	N	N	N	N
9	N	N	N	N	N	N	N	N	N	N	N	N
10	N	N	N	N	N	N	N	N	N	N	N	N
11	N	N	N	N	N	N	N	N	N	N	N	N
12	N	N	N	N	N	N	N	N	N	N	N	N
13	N	N	N	N	N	N	N	N	N	N	N	N
14	N	N	N	N	N	N	N	N	N	N	N	N
15	5	6	4	4	5	4	N	N	N	N	N	N
16	N	N	N	N	N	N	N	N	N	N	N	N
17	N	N	N	N	N	N	N	N	N	N	N	N
18	N	N	N	N	N	N	N	N	N	N	N	N
19	N	N	N	N	N	N	N	N	N	N	N	N
20	N	N	N	N	N	N	N	N	N	N	N	N
21	N	N	N	N	N	N	N	N	N	N	N	N
22	N	N	N	N	N	N	N	N	N	N	N	N
23	N	N	N	N	N	N	N	N	N	N	N	N
24	N	N	N	N	N	N	N	N	N	N	N	N
25	N	N	N	N	N	N	N	N	N	N	N	N
26	3	4	4	N	N	N	N	N	N	N	N	N
27	N	N	N	N	N	N	N	N	N	N	N	N
28	M	M	M	M	M	M	M	M	M	M	M	M
29	M	M	M	M	M	M	M	M	M	M	M	M
30	M	M	M	M	M	M	M	M	M	M	M	M
31	M	M	M	M	M	M	M	M	M	M	M	M

NOTE: FOR TYPE 1=FRONTAL, 2=SUBSIDENCE, 3=RADIATION (SPIKED ECHO)
4=RADIATION (LAMINAR ECHO) 9=UNKNOWN
N=NO INVERSION M=MISSING DATA OR UNKNOWN

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF MAY 1978

******* FIRST INVERSION FREQUENCY OF OCCURENCE TABLE *******

THICKNESS (METERS)	SFC	INVERSION BASE HEIGHT (IN METERS) 100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	6	0	1	0	0	0	0	0	0	0	7
101-300	8	0	0	0	0	0	0	0	0	0	8
301-500	3	0	0	0	0	0	0	0	0	0	3
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											1
TOTAL	17	0	1	0	0	0	0	0	0	0	19
---TIME 601-1200 MST											
001-100	3	2	0	1	1	0	0	0	0	0	7
101-300	2	3	1	0	0	0	0	0	0	0	6
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											6
TOTAL	5	5	1	1	1	0	0	0	0	0	19
---TIME 1201-1800 MST											
001-100	0	0	0	1	0	0	0	0	0	0	1
101-300	1	0	0	0	0	0	0	0	0	0	1
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											18
TOTAL	1	0	0	1	0	0	0	0	0	0	20
---TIME 1801-2400 MST											
001-100	7	0	0	0	0	0	0	0	0	0	7
101-300	8	0	1	0	0	0	0	0	0	0	9
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											4
TOTAL	15	0	1	0	0	0	0	0	0	0	20
---------- FREQUENCY SUMMARY FOR FIRST INVERSION ----------											
001-100	16	2	1	2	1	0	0	0	0	0	22
101-300	19	3	2	0	0	0	0	0	0	0	24
301-500	3	0	0	0	0	0	0	0	0	0	3
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											29
TOTAL	38	5	3	2	1	0	0	0	0	0	78

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF MAY 1978

********** TWO HOUR STABILITY ANALYSIS **********

	HOUR											
DAY	02	04	06	08	10	12	14	16	18	20	22	24
1	M	M	M	M	M	M	M	M	M	M	M	M
2	M	M	M	M	M	M	M	M	M	M	M	M
3	M	M	M	M	M	M	M	M	M	M	M	M
4	M	M	M	M	M	M	M	M	M	M	M	M
5	M	M	M	M	M	M	M	M	M	M	M	M
6	M	M	M	M	M	M	M	M	M	M	M	M
7	M	M	M	M	M	M	M	M	M	M	M	M
8	M	M	M	M	M	M	M	C	C	D	E	E
9	E	E	E	D	D	U	E	D	D	D	E	D
10	D	D	D	D	C	D	D	C	C	D	D	E
11	E	E	E	E	D	D	D	U	D	C	C	E
12	E	E	E	D	C	C	D	C	C	D	E	E
13	E	E	D	D	D	D	D	C	D	E	D	E
14	D	D	D	D	D	D	C	B	B	D	E	E
15	D	D	E	D	D	D	D	D	D	D	E	E
16	E	E	E	D	D	D	D	C	C	D	E	D
17	C	D	D	D	U	C	C	E	D	U	D	E
18	E	E	E	E	D	C	C	D	D	D	D	F
19	F	E	E	E	D	A	B	C	C	C	D	F
20	F	F	F	E	D	A	C	C	C	D	E	E
21	F	F	F	F	D	C	D	D	E	E	E	E
22	E	E	D	D	D	D	C	C	C	D	F	F
23	F	F	F	E	D	D	D	D	D	D	E	D
24	D	D	D	D	D	E	D	D	D	D	F	F
25	F	E	E	E	D	D	C	D	D	D	E	D
26	E	F	F	D	C	D	D	D	D	D	D	E
27	E	E	E	E	D	C	C	C	D	D	E	E
28	M	M	M	M	M	M	M	M	M	M	M	M
29	M	M	M	M	M	M	M	M	M	M	M	M
30	M	M	M	M	M	M	M	M	M	M	M	M
31	M	M	M	M	M	M	M	M	M	M	M	M

PERCENT FREQUENCY OF OCCURENCE FOR EACH CATEGORY

A= 0.5 % B= 1.1 % C= 7.8 % D=29.8 % E=16.9 % F= 5.4 %

U= 1.1 % M=37.4 %

NOTE: U=UNKNOWN M=MISSING DATA
CLOUD COVER CONDITIONS USED FROM NWS STATION AT KALISPELL
WIND DATA USED FROM NWS STATION AT KALISPELL

ACOUSTIC RADAR ANALYSIS

COLUMBIA FALLS METEOROLOGICAL STUDY MONTH OF MAY 1978

******* SECOND INVERSION FREQUENCY OF OCCURENCE TABLE ******

THICKNESS (METERS)	INVERSION BASE HEIGHT (IN METERS) SFC	100	200	300	400	500	600	700	800	900	TOTAL
---TIME 0- 600 MST											
001-100	0	0	0	1	0	1	0	0	0	0	2
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											17
TOTAL	0	0	0	1	0	1	0	0	0	0	19
---TIME 601-1200 MST											
001-100	0	0	0	0	1	0	0	0	0	0	1
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											18
TOTAL	0	0	0	0	1	0	0	0	0	0	19
---TIME 1201-1800 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											20
TOTAL	0	0	0	0	0	0	0	0	0	0	20
---TIME 1801-2400 MST											
001-100	0	0	0	0	0	0	0	0	0	0	0
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											20
TOTAL	0	0	0	0	0	0	0	0	0	0	20
---------- FREQUENCY SUMMARY FOR SECOND INVERSION ----------											
001-100	0	0	0	1	1	1	0	0	0	0	3
101-300	0	0	0	0	0	0	0	0	0	0	0
301-500	0	0	0	0	0	0	0	0	0	0	0
501-900	0	0	0	0	0	0	0	0	0	0	0
NO INVERSION											75
TOTAL	0	0	0	1	1	1	0	0	0	0	78

WIND FREQUENCY TABLE

SITE: Columbia Falls

YEAR: 1977

LEVEL: surface

TIME (AM OR PM): a.m.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N			9.1	16.7	22.7	20.0	21.7		66.7	43.8			16.1	20.9	47.4
NNE															
NE															
ENE							4.3							2.3	
E			4.5	27.8	12.6	25.0	4.3			6.3			14.5	14.0	5.3
ESE		25.0			13.6		4.3						4.8	2.3	
SE			9.1										3.2		
SSE			4.5										1.6		
S		31.3	59.1	27.8	40.9	30.0	56.5			25.0			43.5	44.2	21.1
SSW		31.3	4.5				4.3						1.6	2.3	
SW		12.5				5.0	4.3							4.7	
WSW				5.6									1.6		
W			4.5	22.2	4.5	20.0			33.3	25.0			9.7	9.3	26.3
WNW															
NW															
NNW		4.5		4.5									3.2		

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

YEAR: 1977

LEVEL: surface

TIME (AM OR PM) : a.m.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N			4.5	2.9	2.5	2.3	4.8		2.9	2.6			3.3	3.6	2.8
NNE															
NE															
ENE							0.9							0.9	
E			2.3	5.6	6.2	2.0	0.9			1.8			4.7	1.5	1.8
ESE		11.3			3.0		0.9						3.0	0.9	
SE			4.1										4.1		
SSE			2.3										2.3		
S		6.5	6.7	3.2	2.8	1.6	2.3			2.3			4.2	2.0	2.3
SSW		4.7	6.8				3.6						6.8	3.6	
SW		4.5				4.5	4.5							4.5	
WSW				4.5									4.5		
W				4.4	1.8	1.4			3.2	3.6			3.1	1.4	3.4
WNW															
NW															
NNW			4.5		4.5								4.5		
TOTAL		6.9	5.7	4.2	3.3	1.9	2.8		3.0	2.7			4.4	2.4	2.9

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

YEAR: 1977

LEVEL: surface

TIME (AM OR PM): p.m.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N		9.1	8.3							25.0			2.0		20.0
NNE		9.1													
NE		9.1													
ENE		9.1													
E		18.2		10.0	5.6	12.5							6.0	4.0	
ESE		9.1		5.0	11.1								6.0		
SE				5.0									2.0		
SSE				5.0									2.0		
S		36.4	8.3	25.0	61.1	87.5	76.5		100.0	25.0			34.0	80.0	40.0
SSW			8.3	5.0			5.9						4.0	4.0	
SW		25.0	20.0	16.7		11.8							20.0	8.0	
WSW				5.0			5.9						2.0	4.0	
W			25.0	20.0	5.6					50.0			16.0		40.0
WNW		8.3											2.0		
NW															
NNW		16.7											4.0		

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls YEAR: 1977

LEVEL: surface TIME (AM OR PM) : p.m.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N		3.6	4.5							3.5			4.5		3.5
NNE															
NE		2.3													
ENE		9.1													
E		6.4		7.1	1.4	1.8							4.3	1.8	
ESE		4.5		2.3	3.6								3.0		
SE				3.6									3.6		
SSE				2.3									2.3		
S		5.4	4.5	6.2	3.2	4.5	2.2		2.5	2.3			4.6	3.4	2.4
SSW			2.3	8.2			4.5						5.3	4.5	
SW			5.3	4.2	2.7		3.6						4.1	3.6	
WSW				4.5			4.5						4.5	4.5	
W			2.3	4.9	2.3					2.3			3.2		2.3
WNW			3.6										3.6		
NW															
NNW			5.0										5.0		
TOTAL		5.1	4.0	5.1	3.1	4.3	2.6		2.5	2.6			4.1	3.5	2.6

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

YEAR: 1977

LEVEL: 100 meters

TIME (AM OR PM): a.m.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N			4.8	18.8	9.1	5.0	8.7		57.1				10.2	7.0	17.4
NNE		6.3	4.8	6.3		5.0							3.4	2.3	
NE					9.1	10.0	4.3						3.4	7.0	
ENE					9.1		4.3			6.3			3.4	2.3	4.3
E		6.3	4.8		9.1	5.0	4.3			6.3			5.1	4.7	4.3
ESE			9.5		9.1	5.0	8.7		14.3				6.8	7.0	4.3
SE			19.0	6.3	4.5	5.0	4.3			6.3			10.2	4.7	4.3
SSE		18.8	14.3		9.1	5.0	13.0						8.5	9.3	
S		18.8	23.8		13.6	10.0	8.7						13.6	9.3	
SSW		25.0	14.3	31.3	4.5	15.0	21.7			25.0			15.3	18.6	17.4
SW		12.5	4.8	6.3	4.5	10.0	17.4						5.0	14.0	
WSW		6.3			4.5	10.0				12.5			1.7	4.7	8.7
W					4.5	10.0				6.3			1.7	4.7	4.3
WNW		6.3		6.3						18.8			1.7		13.0
NW		6.3	4.5							12.5			3.4		8.7
NNW				12.5	4.5		4.3		28.6	6.3			5.1	2.3	13.0

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

YEAR: 1977

LEVEL: 100 meters

TIME (AM OR PM) : a.m.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N			1.9	3.3	1.0	0.7	0.7		1.3				3.0	0.7	1.3
NNE		0.5	3.3	8.2		2.1							5.8	2.1	
NE					4.6	1.6	2.7						4.6	2.2	
ENE					3.1		1.3			1.4			3.1	1.3	1.4
E		2.3	1.0		4.5	1.1	1.1			0.5			2.8	1.1	0.5
ESE			2.5		2.6	0.9	1.0		0.8				2.6	1.0	0.8
SE			4.1	3.8	0.4	6.2	1.2			0.3			2.8	3.7	0.3
SSE		2.6	4.0		1.3	1.2	1.7						2.7	1.5	
S		1.9	8.6	4.7	3.4	7.8	3.7						5.6	5.8	
SSW		3.9	2.8	2.8	1.4	5.4	4.7			3.6			2.3	5.1	3.6
SW			0.6	3.1	1.0	2.0	3.0						1.6	2.5	
WSW					0.7	1.3				4.9			0.7	1.3	4.9
W					0.8	1.6				3.3			0.8	1.6	3.3
WNW		0.8		2.7						2.3			2.7		2.3
NW				1.8	1.4					2.9			1.6		2.9
NNW				2.6	0.9	0.6	0.8		1.7	1.0			1.8	0.7	1.4
TOTAL		2.7	4.4	3.6	2.3	2.8	2.4		1.3	3.0			3.4	2.6	2.2

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 100 meters

YEAR: 1977

TIME (AM OR PM): p.m.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N					5.9					6.3			2.0	4.2	
NNE			8.3	5.0		5.0				6.3			4.1	2.7	4.2
NE				5.0	5.9		5.9						4.0	2.7	
ENE				5.0	5.9				12.5	6.3			4.1		8.3
E		10.0	8.3	5.0	5.9		5.9			6.3			6.1	2.7	4.2
ESE					5.9				12.5				2.0		4.2
SE			8.3	5.0			11.8		50.0				4.0	5.4	16.7
SSE		20.0	25.0		17.6	10.0	23.5		12.5				12.2	16.2	4.2
S		10.0	16.7	20.0	11.8	35.0	11.8						16.3	24.3	
SSW		40.0	25.0	45.0	17.6	35.0	5.9		12.5	6.3			30.6	21.6	8.3
SW		20.0		5.0	11.8	5.0	5.9			6.3			6.1	5.4	4.2
WSW							17.6			6.3				8.1	4.2
W			8.3		5.9					18.8			4.1		12.5
WNW										6.3					4.2
NW					5.9	10.0	5.9			25.0			2.0	8.1	16.7
NNW				5.0			5.9			6.3			2.0	2.7	4.2

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: 100 meters

YEAR: 1977

TIME (AM OR PM) : p.m.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N					8.3					0.8			8.3		0.8
NNE			2.7	0.4		1.8				0.5			1.6	1.8	0.5
NE				4.6	2.1		0.4						3.9	0.4	
ENE				7.2	6.1				0.7	1.0			6.7		0.9
E		3.6	1.6	3.1	1.8		0.6			1.6			2.2	0.6	1.6
ESE					0.7				1.3				0.7		1.3
SE			2.3	5.3			0.7						3.8	0.7	
SSE		3.1	3.3		2.1	4.6	3.2						2.7	3.9	
S		4.3	6.5	2.0	2.6	3.5	0.6						3.7	2.1	
SSW		4.6	2.5	7.3	4.4	4.1	1.5		0.7	1.7			4.7	2.8	1.2
SW		2.0		10.3	2.1	0.2	2.4						6.2	1.3	
WSW							3.7			3.8				3.7	3.8
W			1.0		0.9					3.4			1.0		3.4
WNW										0.5					0.5
NW					0.6	0.5	1.2			1.3			0.6	0.9	1.3
NNW				0.6			1.3			2.1			0.6	1.3	2.1
TOTAL		3.5	3.2	5.3	2.9	3.3	2.0		0.9	1.8			3.8	2.7	1.4

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 200 meters

YEAR: 1977

TIME (AM OR PM): a.m.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N				15.8	4.5		4.3			6.3			6.5	2.3	4.5
NNE		6.3	4.8	21.1	4.5		4.3						9.7	2.3	
NE			4.8	5.3	4.5		4.3		16.7				4.8	2.3	4.5
ENE					4.5					6.3			1.6		4.5
E		12.5	4.8		9.1				16.7	6.3			4.8		9.1
ESE			4.8						16.7				1.6		4.5
SE			4.8		4.5	10.0	8.7		16.7	6.3			3.2	9.3	9.1
SSE		12.5	4.8		4.5	15.0	4.3						3.2	9.3	
S		18.8	23.8	5.3	31.8	35.0	17.4			6.3			21.0	25.6	4.5
SSW		25.0	23.8	26.3	4.5	5.0	26.1			12.5			17.7	16.3	9.1
SW		12.5	4.8		4.5		13.0		16.7	6.3			3.2	7.0	9.1
WSW		6.3	4.8		4.5	5.0				6.3			3.2	2.3	4.5
W				15.8		10.0				25.0			4.8	4.7	18.2
WNW			6.3	9.5						6.3			3.2		4.5
NW					9.1	15.0	13.0			6.3			3.2	14.0	4.5
NNW			4.8	10.5	9.1	5.0	4.3		16.7	6.3			8.1	4.7	9.1

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

YEAR: 1977

LEVEL: 200 meters

TIME (AM OR PM) : a.m.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N				1.7	1.5					0.7			1.6		0.7
NNE		0.8	0.7	4.4	3.0		0.4						2.7	0.4	
NE			0.1	1.3	4.4		3.3		1.6				1.9	3.3	1.6
ENE					3.1					1.2			3.1		1.2
E		3.6	1.9		3.4				0.6	0.9			2.7		0.8
ESE			0.9						0.8				0.9		0.8
SE			1.2		1.2	0.7	2.3		1.3	1.4			1.2	1.5	1.4
SSE			0.7		1.0	2.0	1.3						0.9	1.7	
S		3.4	4.9	4.1	2.0	4.9	2.8			2.5			3.7	3.9	2.5
SSW		4.1	3.7	3.3	2.4	1.5	4.8			5.1			3.1	3.2	5.1
SW		2.4	2.4		0.5		4.4		0.4	1.4			1.5	4.4	0.9
WSW		4.6	0.3	1.4	0.8	1.5				4.0			2.1	1.2	4.0
W				2.9		1.2				4.6			2.9	1.2	4.6
WNW			1.9							0.4			1.9		0.4
NW					1.4	0.7	0.7			2.9			1.4	0.7	2.9
NNW		0.7	2.1	1.3	0.9	0.4			1.3	1.2			1.4	0.7	1.3
TOTAL		3.4	2.7	2.9	2.0	2.5	3.0		0.9	2.8			2.5	2.3	1.9

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 200 meters

YEAR: 1977

TIME (AM OR PM): p.m.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N		10.0				5.0				6.3				2.7	4.2
NNE										6.3					4.2
NE							5.9							2.7	
ENE						5.0				12.5				2.7	8.3
E									12.5	6.3				8.3	
ESE				5.0	5.6								4.3		
SE		10.0	22.2	5.0	11.1		5.9		12.5				10.6	2.7	4.2
SSE		10.0	11.1	15.0		5.0	23.5		25.0				8.5	13.5	8.3
S		10.0	33.3	25.0	16.7	25.0	23.5		12.5				23.4	24.3	4.2
SSW		30.0	11.1	30.0	33.3	55.0	5.9		25.0				27.7	32.4	8.3
SW		20.0		5.0	11.1		5.9						6.4	2.7	
WSW				5.0	16.7		5.9			25.0			8.5	2.7	16.7
W				5.0	5.6	5.0	23.5			12.5			4.3	13.5	8.3
WNW			11.1							18.8			2.1		12.5
NW									12.5	6.3					8.3
NNW		10.0	11.1	10.0						6.3			6.4		4.2

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

YEAR: 1977

LEVEL: 200 meters

TIME (AM OR PM) : p.m.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N		0.7				8.5				1.2				8.5	1.2
NNE										1.0					1.0
NE							0.4							0.4	
ENE						0.3				0.9				0.3	0.9
E									0.9	0.2					0.6
ESE				3.9	2.1								3.0		
SE		6.6	16.9	2.3	1.5		2.9						6.9	2.9	
SSE		4.6	3.5	4.1		4.5	3.2		0.6				3.8	3.9	0.6
S		4.7	3.9	3.7	3.4	4.7	1.3		4.5				3.7	3.0	4.5
SSW		4.2	1.5	5.2	4.3	4.9	1.6		2.1				3.7	3.3	2.1
SW		2.0		3.5	1.3		1.3						2.4	1.3	
WSW				2.7	1.5		5.7			3.2			2.1	5.7	3.2
W				0.4	1.7	1.6	1.8			3.3			1.1	1.7	3.3
WNW			2.2							1.6			2.2		1.6
NW									0.5	2.6					1.6
NNW		0.6	1.4	0.9						1.0			1.2		1.0
TOTAL		3.4	5.5	3.6	2.9	4.6	2.1		1.6	2.0			4.0	3.4	1.8

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 300 meters

YEAR: 1977

TIME (AM OR PM): a.m.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N				7.1		5.0							1.8	2.3	
NNE				7.1					28.6				1.8		8.7
NE				7.1						6.3			1.8		4.3
ENE					9.1		4.3			6.3			3.6	2.3	4.3
E		7.1	5.0	7.1	4.5								5.4		
ESE		14.3			9.1	5.0	8.7		14.3				3.6	7.0	4.3
SE		7.1	10.0	7.1	9.1		8.7		14.3				8.9	4.7	4.3
SSE			5.0		9.1	15.0			28.6				5.4	7.0	8.7
S		28.6	15.0		13.6	10.0	17.4		14.3				10.7	14.0	4.3
SSW		35.7	20.0	50.0	13.6	15.0	13.0			18.8			25.0	14.0	13.0
SW			20.0		9.1	15.0	17.4			12.5			10.7	16.3	8.7
WSW		7.1	10.0		9.1	5.0	8.7						7.1	7.0	
W			15.0	7.0		10.0	4.3			43.8			7.1	7.0	30.4
WNW					13.6	5.0	4.3						5.4	4.7	
NW						10.0	4.3			6.3				7.0	4.3
NNW															

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: 300 meters

YEAR: 1977

TIME (AM OR PM) : a.m.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N				1.2		2.9							1.2	2.9	
NNE				1.1					0.6				1.1		0.6
NE				0.8						0.8			0.8		0.8
ENE					2.4		1.4			0.3			2.4	1.4	0.3
E		4.6		5.2	7.0								6.1		
ESE		2.2			6.4	1.4	4.8		0.7				6.4	3.1	0.7
SE		2.2	4.1	1.0	1.5		2.0		1.1				3.2	2.0	1.1
SSE			2.3		3.8	3.5			2.2				3.1	3.5	2.2
S		4.7	9.0		1.8	6.7	5.3		0.7				5.4	6.0	0.7
SSW		3.6	1.7	3.0	2.9	3.2	4.0			2.8			2.5	3.6	2.8
SW			3.5		1.6	2.9	4.5			2.4			2.6	3.7	2.4
WSW		4.6	2.1		1.3	2.1	1.9						1.7	2.0	
W			2.6	2.4		1.0	0.3			3.9			2.5	0.7	3.9
WNW					1.4	0.6	0.7						1.4	0.7	
NW						1.0	0.7			1.1				0.9	1.1
NNW				6.7		1.1	2.1			0.8			6.7	1.6	0.8
TOTAL		3.7	3.9	2.8	2.7	2.7	3.3		1.1	2.7			3.1	3.0	1.9

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 300 meters

YEAR: 1977

TIME (AM OR PM): p.m.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N										6.3					4.2
NNE										18.8					12.5
NE		11.1													
ENE		11.1								6.3					4.2
E															
ESE		11.1		5.0	6.3								4.2		
SE		11.1	8.3	15.0	6.3	5.0	11.8		12.5				10.4	8.1	4.2
SSE			8.3	10.0		5.0	17.6		12.5	6.3			6.3	10.8	8.3
S			33.3	15.0	18.8	30.0	11.8		25.0				20.8	21.6	8.3
SSW		55.6	33.3	30.0	18.8	30.0	17.6		25.0				27.1	24.3	8.3
SW			16.7	20.0	12.5	15.0	11.8						16.7	13.5	
WSW					31.3	10.0	17.6		12.5	12.5			10.4	13.5	12.5
W					6.3	5.0	11.8			18.8			2.1	8.1	12.5
WNW										12.5					8.3
NW										12.5					8.3
NNW				5.0					12.5	6.3			2.1		8.3

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

YEAR: 1977

LEVEL: 300 meters

TIME (AM OR PM) : p.m.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N										0.6					0.6
NNE										2.3					2.3
NE		0.6													
ENE		1.1								0.6					0.6
E															
ESE		5.2		1.6	3.7								2.7		
SE		2.7	8.8	2.8	3.9	0.4	3.0		0.8				5.2	1.7	0.8
SSE			5.4	2.1		2.7	2.9		2.5	1.1			3.8	2.8	1.8
S			4.7	4.0	2.4	5.7	1.9		2.8				3.7	3.8	2.8
SSW		4.1	5.2	6.3	7.3	7.1	2.4		2.5				6.3	4.8	2.5
SW			3.9	4.7	3.5	3.0	1.6						4.0	2.3	
WSW					2.5	2.0	4.3		0.9	4.2			2.5	3.2	2.6
W					4.7	5.0	2.3			4.3			4.7	3.7	4.3
WNW										5.4					5.4
NW										2.0					2.0
NNW					0.6				0.4	1.0			0.6		0.7
TOTAL		3.5	5.1	4.2	3.9	4.9	2.7		1.9	2.9			4.4	3.8	2.4

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 500 meters

YEAR: 1977

TIME (AM OR PM): a.m.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N				7.1		6.3	17.6			9.1			2.2	12.1	6.3
NNE															
NE															
ENE															
E		12.5													
ESE		12.5			26.7								8.9		
SE				21.4	6.7		11.8		20.0	9.1			8.9	6.1	12.5
SSE			6.3	14.3	13.3	6.3			20.0	9.1			11.1	3.0	12.5
S			31.3	14.3	20.0	18.8	11.8			18.2			22.2	15.2	12.5
SSW		37.5	25.0	28.6	20.0	37.5	23.5		20.0	9.1			24.4	30.3	12.5
SW		25.0	18.8	14.3	6.7	18.8	17.6						13.3	18.2	
WSW		12.5	12.5		6.7		5.9			9.1			6.7	3.0	6.3
W										9.1					6.3
WNW							5.9		40.0	18.2				3.0	25.0
NW			6.3			6.3	5.9			9.1			2.2	6.1	6.3
NNW						6.3								3.0	

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

YEAR: 1977

LEVEL: 500 meters

TIME (AM OR PM) : a.m.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N				6.2		1.0	1.2			2.1			6.2	1.1	2.1
NNE															
NE															
ENE															
E		3.0													
ESE		5.7			4.1								4.1		
SE		2.6		5.0	5.3		5.1		0.8	1.9			5.2	5.1	1.4
SSE			4.5	2.4	4.3	1.1			1.7	0.4			3.7	1.1	1.1
S			5.5	3.0	5.2	4.5	5.4			6.7			4.6	5.0	6.7
SSW		5.4	4.7	6.7	4.0	6.5	6.7		0.7	5.0			5.1	6.6	2.9
SW		5.3	4.7	3.8	1.9	3.6	9.0						3.5	6.3	
WSW		4.6	7.3		1.9		2.6			7.1			4.8	2.6	7.1
W										5.5					5.5
WNW							1.2		3.9	6.8				1.2	5.4
NW			16.7			0.5	3.1			4.9			16.7	1.8	4.9
NNW						1.0								1.0	
TOTAL		4.8	6.0	4.7	4.1	4.2	5.0		2.2	4.9			4.9	4.6	3.6

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

YEAR: 1977

LEVEL: 500 meters

TIME (AM OR PM): p.m.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N										8.3					5.9
NNE															
NE							9.1							4.0	
ENE										8.3				5.9	
E															
ESE		16.7					9.1							4.0	
SE		16.7		13.3			9.1						5.4	4.0	
SSE															
S			44.4	20.0	15.4	28.6	9.1		20.0	8.3			24.3	20.0	11.8
SSW		33.3	22.2	20.0	38.5	35.7	18.2		60.0				27.0	28.0	17.6
SW		33.3	11.1	46.7	15.4	28.6	9.1						27.0	20.0	
WSW			11.1		23.1		36.4		20.0				10.8	16.0	5.9
W			11.1							41.7			2.7		29.4
WNW										8.3					5.9
NW															
NNW					7.7	7.1				25.0			2.7	4.0	17.6

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

YEAR: 1977

LEVEL: 500 meters

TIME (AM OR PM) : p.m.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N										0.5					0.5
NNE															
NE							1.3							1.3	
ENE										1.0					1.0
E															
ESE		2.6					5.0							5.0	
SE		1.3		3.5			8.6						3.5	8.6	
SSE															
S			14.0	5.8	3.0	4.3	4.6		1.3	8.1			7.6	4.5	4.7
SSW		4.4	6.9	3.9	4.4	6.4	3.1		5.6				5.1	4.8	4.4
SW		6.6	6.4	5.3	2.1	4.2	4.5						4.6	4.4	
WSW			4.8		2.4		4.7		1.5				3.6	4.7	1.5
W			3.4							6.5			3.4		6.5
WNW										5.3					5.3
NW															
NNW					4.6	1.5				4.5			4.6	1.5	4.5
TOTAL		4.3	9.4	4.9	3.4	4.8	4.4		4.2	5.1			5.9	4.6	4.7

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 750 meters

YEAR: 1977

TIME (AM OR PM): a.m.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N										11.1					7.7
NNE							6.3							3.3	
NE															
ENE				8.3									2.8		
E		16.7		8.3						11.1			2.8		7.7
ESE					7.7								2.8		
SE		16.7		8.3	15.4		6.3						8.3	3.3	
SSE		16.7		25.0			12.5						8.3	6.7	
S			36.4	8.3	15.4	7.1			25.0	11.1			19.4	3.3	15.4
SSW		33.3	27.3	16.7	30.8	35.7	31.3		25.0	22.2			25.0	33.3	23.1
SW		16.7	27.3		15.4	50.0	25.0		50.0	11.1			13.9	36.7	23.1
WSW			9.1	16.7	15.4								13.9		
W							18.8							10.0	
WNW				8.3						22.2			2.8		15.4
NW										11.1					7.7
NNW						7.1								3.3	

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

YEAR: 1977

LEVEL: 750 meters

TIME (AM OR PM) : a.m.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE							1.3							1.3	
NE															
ENE				12.4									12.4		
E		1.6		4.7						0.4			4.7		0.4
ESE					7.8								7.8		
SE		2.4		9.0	6.5		11.6						7.8	11.6	
SSE		5.7		1.9			1.9						1.9	1.9	
S			6.4	1.4	7.9	12.5			10.2	3.8			5.2	12.5	7.0
SSW		6.7	10.1	7.6	10.4	6.2	9.2		7.0	10.8			9.4	7.7	8.9
SW		4.4	9.2		2.6	6.7	7.9		3.0	9.8			5.9	7.3	6.4
WSW			7.1	4.2	1.6								4.3		
W							9.4							9.4	
WNW				2.2						14.3			2.2		14.3
NW										11.0					11.0
NNW						8.5								8.5	
TOTAL		4.6	8.4	4.9	6.6	7.1	7.7		5.2	9.4			6.6	7.4	7.3

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 750 meters

YEAR: 1977

TIME (AM OR PM): p.m.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE			11.1							10.0			3.0		8.3
ENE															
E															
ESE					8.3								3.0		
SE		66.7		16.7	8.3		9.1						9.1	4.3	
SSE				8.3			9.1			10.0			3.0	4.3	8.3
S			11.1	8.3		16.7	18.2		50.0				6.1	17.4	8.3
SSW			22.2	16.7	33.3	50.0	18.2		50.0	20.0			24.2	34.8	25.0
SW			11.1	16.7	8.3	16.7	18.2						12.1	17.4	
WSW		33.3	11.1	16.7	25.0	8.3	27.3			10.0			18.2	17.4	8.3
W			11.1	8.3	16.7								12.1		
WNW			11.1			8.3				30.0			3.0	4.3	25.0
NW			11.1										3.0		
NNW				8.3						20.0			3.0		16.7

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

YEAR: 1977

LEVEL: 750 meters

TIME (AM OR PM) : p.m.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE			3.1							7.2			3.1		7.2
ENE															
E															
ESE					4.3								4.3		
SE		4.4		4.4	1.7		6.7						3.1	6.7	
SSE				1.2			4.7			2.0			1.2	4.7	2.0
S			14.2	1.3		6.9	4.2		5.8				7.3	5.6	5.8
SSW			5.9	7.3	5.9	8.1	3.6		5.9	2.6			6.4	5.9	4.3
SW			5.1	8.1	6.2	9.8	3.5						6.5	6.7	
WSW		7.1	4.5	4.6	7.2	5.5	9.6			8.1			5.4	7.6	8.1
W		6.2	7.1	1.9	2.9								4.0		
WNW			6.9			2.3				7.4			6.9	2.3	7.4
NW			1.7										1.7		
NNW				3.5						11.7			3.5		11.7
TOTAL		5.9	6.0	4.7	5.3	7.5	5.7		5.9	6.8			5.3	6.6	6.4

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 1000 meters

YEAR: 1977

TIME (AM OR PM): a.m.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE							8.3							5.0	
NE															
ENE															
E				25.0									8.3		
ESE															
SE					11.1		8.3						4.2	5.0	
SSE		100.0			11.1					20.0			4.2		16.7
S						25.0	8.3							15.0	
SSW			57.1		11.1	12.5	8.3						20.8	10.0	
SW			28.6	37.5	33.3	12.5	33.3		100.0	40.0			33.3	25.0	50.0
WSW				25.0	33.3	37.5	25.0			20.0			20.8	30.0	16.7
W				12.5			8.3						4.2	5.0	
WNW			14.3										4.2		
NW										20.0					16.7
NNW						12.5								5.0	

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: 1000 meters

YEAR: 1977

TIME (AM OR PM) : a.m.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE							11.1							11.1	
NE															
ENE															
E				10.6									10.6		
ESE															
SE					5.1		8.6						5.1	8.6	
SSE		4.5			5.2					0.6			5.2		0.6
S						6.0	5.7							5.9	
SSW			9.8		7.5	4.9	5.0						8.7	5.0	
SW			12.6	4.8	7.8	15.4	13.1		5.4	11.0			8.4	14.3	8.2
WSW				5.3	2.3	9.6	5.1			0.6			3.8	7.4	0.6
W				8.2			22.0						8.2	22.0	
WNW			1.9										1.9		
NW										17.6					17.6
NNW						8.5								8.5	
TOTAL		4.5	9.4	6.8	5.4	8.7	10.0		5.4	8.1			7.2	9.4	6.8

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 1000 meters

YEAR: 1977

TIME (AM OR PM): p.m.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE			20.0							14.3			5.6		12.5
ENE															
E															
ESE		50.0		14.3			20.0						5.6	7.7	
SE				14.3									5.6		
SSE							20.0							7.7	
S			20.0										5.6		
SSW						50.0	20.0		100.0	28.6				38.5	37.5
SW			20.0	57.1	33.3	25.0	40.0						38.9	30.8	
WSW			20.0	14.3	16.7	12.5							16.7	7.7	
W			20.0		50.0	12.5				14.3			22.2	7.7	12.5
WNW		50.0								28.6					25.0
NW															
NNW										14.3					12.5

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: 1000 Meters

YEAR: 1977

TIME (AM OR PM) : p.m.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE			3.1							7.2			3.1		7.2
ENE															
E															
ESE		0.9		4.5			6.7						4.5	6.7	
SE				4.6									4.6		
SSE							8.0							8.0	
S			12.8										12.8		
SSW						10.5	8.6		8.0	5.5				9.6	6.8
SW			5.8	7.0	6.9	6.7	3.0						6.6	4.9	
WSW			2.7	8.6	13.8	9.2							8.4	9.2	
W			13.6		4.7	4.9				13.1			9.2	4.9	13.1
WNW		13.4								9.0					9.0
NW															
NNW										24.0					24.0
TOTAL		7.2	7.6	6.5	7.0	8.7	5.9		8.0	10.5			7.0	7.3	9.3

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: surface

YEAR: 1977

TIME (AM OR PM): a.m. #1 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N			16.7	40.0	33.3	20.0	28.6		100.0	25.0			29.4	25.0	40.0
NNE															
NE															
ENE															
E			16.7	20.0		40.0				25.0			11.8	16.7	20.0
ESE		25.0			16.7								5.9		
SE															
SSE															
S		25.0	50.0	20.0	16.7	20.0	57.1			25.0			29.4	41.7	20.0
SSW		25.0	16.7				14.3						5.9	8.3	
SW		25.0													
WSW															
W				20.0	16.7	20.0				25.0			11.8	8.3	20.0
WNW															
NW															
NNW					16.7								5.9		

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: Surface

YEAR: 1977

TIME (AM OR PM) : a.m. #1 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N		3.6	3.6	3.0	1.9	2.3	4.6		2.3	3.2			2.6	3.8	2.8
NNE															
NE		2.3													
ENE															
E			2.3	6.8		2.1				1.8			2.3	2.1	1.8
ESE		11.3			3.6								3.6		
SE															
SSE															
S		6.8	5.7	3.6	3.2	1.4	2.2			2.3			4.8	2.0	2.3
SSW		4.5	6.8				3.6						6.8	3.6	
SW		4.5													
WSW															
W				3.6	1.8	1.4				3.6			2.8	1.4	3.6
WNW															
NW															
NNW					4.5								4.5		
TOTAL		5.5	5.3	4.0	2.8	1.9	3.1		2.3	2.7			3.5	2.6	2.6

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: surface

YEAR: 1977

TIME (AM OR PM): a.m. #2 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N					16.7	20.0	16.7		50.0	50.0			5.6	18.2	50.0
NNE															
NE															
ENE							16.7							9.1	
E				50.0	16.7	40.0							22.2	18.2	
ESE		25.0			16.7								5.6		
SE			33.3										11.1		
SSE															
S		25.0	50.0	16.7	50.0	20.0	50.0			25.0			38.9	36.4	16.7
SSW		25.0													
SW		25.0					16.7							9.1	
WSW															
W			16.7	33.3		20.0			50.0	25.0			16.7	9.1	33.3
WNW															
NW															
NNW															

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

YEAR: 1977

LEVEL: Surface

TIME (AM OR PM) : a.m. #2 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N					5.4	2.3	6.8		2.3	2.5			5.4	4.6	2.4
NNE															
NE															
ENE							0.9							0.9	
E				4.8	1.8	2.1							4.1	2.1	
ESE		11.3			3.2								3.2		
SE			4.1										4.1		
SSE															
S		6.8	7.4	2.3	2.6	1.4	2.1			2.3			4.6	1.9	2.3
SSW		4.5													
SW		4.5					4.5							4.5	
WSW															
W			1.4	4.3		1.4			3.2	3.6			3.3	1.4	3.4
WNW															
NW															
NNW															
TOTAL		6.8	5:3	4.2	3.0	1.8	3.1		2.8	2.7			3.7	2.1	2.7

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

YEAR: 1977

LEVEL: surface

TIME (AM OR PM): a.m. #3 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N				25.0	20.0	16.7	20.0		50.0	50.0			13.3	18.2	50.0
NNE															
NE															
ENE															
E					20.0	16.7							6.7	9.1	
ESE		25.0					20.0							9.1	
SE															
SSE			16.7										6.7		
S		25.0	66.7	25.0	60.0	33.3	60.0			25.0			53.3	45.5	16.7
SSW		50.0													
SW															
WSW				25.0									6.7		
W				25.0		33.3			50.0	25.0			6.7	18.2	33.3
WNW															
NW															
NNW			16.7										6.7		

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: Surface

YEAR: 1977

TIME (AM OR PM) : a.m. #3 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N				2.7	1.8	2.3	5.9		2.3	2.5			2.3	4.1	2.4
NNE															
NE															
ENE															
E					7.7	1.8							7.7	1.8	
ESE		11.3					0.9							0.9	
SE															
SSE			2.3										2.3		
S		6.8	6.9	2.3	2.7	2.5	2.4			2.3			4.8	2.4	2.3
SSW		4.5													
SW															
WSW				4.5									4.5		
W				5.4		1.4			3.2	3.6			5.4	1.4	3.4
WNW															
NW															
NNW			4.5										4.5		
TOTAL		6.8	5.7	3.7	3.5	2.0	2.8		2.8	2.7			4.5	2.3	2.7

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: surface

YEAR: 1977

TIME (AM OR PM): a.m. #4 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N			25.0		20.0	25.0	20.0		100.0	50.0			16.7	18.2	60.0
NNE															
NE															
ENE															
E				33.3	20.0		20.0						16.7	9.1	
ESE		25.0			20.0								8.3		
SE															
SSE															
S		50.0	75.0	66.7	40.0	50.0	60.0			25.0			58.3	45.5	20.0
SSW		25.0													
SW						25.0								18.2	
WSW															
W										25.0					20.0
WNW															
NW															
NNW															

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

YEAR: 1977

LEVEL: Surface

TIME (AM OR PM) : a.m. #4 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N			5.4		1.8	2.3	2.3		2.8	2.5			3.6	2.3	2.6
NNE															
NE															
ENE															
E				6.8	9.1		0.9						8.0	0.9	
ESE		11.3			2.3								2.3		
SE															
SSE															
S		6.1	6.5	3.9	3.2	1.6	2.4			2.3			4.8	2.1	2.3
SSW		4.5													
SW						4.5								4.5	
WSW															
W										3.6				3.6	
WNW															
NW															
NNW															
TOTAL		7.0	6.2	4.9	3.9	2.5	2.1		2.8	2.7			4.9	2.3	2.7

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: surface

YEAR: 1977

TIME (AM OR PM): p.m. #1 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N		33.3								20.0					16.7
NNE															
NE		33.3													
ENE															
E				20.0	25.0	20.0							15.4	12.5	
ESE															
SE															
SSE															
S		33.3	25.0	20.0	75.0	80.0	66.7		100.0	20.0			38.5	75.0	33.3
SSW			25.0										7.7		
SW			25.0	20.0			33.3						15.4	12.5	
WSW				20.0									7.7		
W				20.0						60.0			7.7	50.0	
WNW															
NW															
NNW			25.0										7.7		

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: Surface

YEAR: 1977

TIME (AM OR PM) : p.m. #1 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N		3.6								4.1					4.1
NNE															
NE		2.3													
ENE															
E				7.3	1.4	1.8							4.4	1.8	
ESE															
SE															
SSE															
S		4.5	4.5	5.4	3.3	4.9	1.9		2.5	2.3			4.0	3.9	2.4
SSW			2.3										2.3		
SW			6.8	3.2			3.6						5.0	3.6	
WSW				4.5									4.5		
W				4.1						2.3			4.1		2.3
WNW															
NW															
NNW			5.4										5.4		
TOTAL		3.4	4.8	4.9	2.8	4.3	2.5		2.5	2.7			4.2	3.6	2.6

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: surface

YEAR: 1977

TIME (AM OR PM): p.m. #2 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N										33.3					25.0
NNE		25.0													
NE															
ENE															
E		25.0													
ESE		25.0		20.0									8.3		
SE															
SSE															
S		25.0		40.0	50.0	100.0	75.0		100.0	33.3			33.3	80.0	50.0
SSW															
SW			33.3	20.0	25.0								25.0		
WSW							25.0							20.0	
W			33.3	20.0	25.0					33.3			25.0		25.0
WNW															
NW															
NNW			33.3										8.3		

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: Surface

YEAR: 1977

TIME (AM OR PM) : p.m. #2 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N										3.6					3.6
NNE															
NE		2.3													
ENE															
E		8.2													
ESE		4.5		2.3									2.3		
SE															
SSE															
S		4.5		6.8	3.2	4.4	2.0		2.5	2.3			5.0	2.6	2.4
SSW															
SW		4.5	4.5	2.7									3.9		
WSW							4.5							4.5	
W			1.4	5.4	2.3					2.3			3.0		2.3
WNW															
NW															
NNW			4.5										4.5		
TOTAL		4.9	3.5	5.2	2.9	4.4	2.6		2.5	2.7			4.0	3.0	2.7

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: surface

YEAR: 1977

TIME (AM OR PM): p.m. #3 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N			50.0							25.0			8.3		20.0
NNE															
NE															
ENE		50.0													
E			20.0										8.3		
ESE					20.0								8.3		
SE				20.0									8.3		
SSE															
S		50.0		40.0	60.0	100.0	80.0		100.0	25.0			41.7	83.3	40.0
SSW															
SW					20.0		20.0						8.3	16.7	
WSW															
W			50.0	20.0						50.0			16.7		40.0
WNW															
NW															
NNW															

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: Surface

YEAR: 1977

TIME (AM OR PM) : p.m. #3 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N			4.5							3.6			4.5		3.6
NNE															
NE															
ENE		9.1													
E				6.8									6.8		
ESE					3.6								3.6		
SE				3.6									3.6		
SSE															
S		5.9		5.9	3.2	4.2	2.4		2.5	2.3			4.3	2.8	2.4
SSW															
SW					2.7		3.6						2.7	3.6	
WSW															
W			1.4	5.4						2.3			3.4		2.3
WNW															
NW															
NNW															
TOTAL		7.5	3.0	5.5	3.2	4.2	2.6		2.5	2.6			4.1	2.9	2.6

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: surface

YEAR: 1977

TIME (AM OR PM): p.m. #4 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N										25.0					20.0
NNE															
NE															
ENE															
E		50.0													
ESE					20.0								7.7		
SE															
SSE				20.0									7.7		
S		50.0			60.0	100.0	80.0		100.0	25.0			23.1	83.3	40.0
SSW				20.0			20.0						7.7	16.7	
SW			33.3	40.0	20.0								30.8		
WSW															
W			33.3	20.0						50.0			15.4		40.0
WNW			33.3										7.7		
NW															
NNW															

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: Surface

YEAR: 1977

TIME (AM OR PM) : P.M. #4 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N										2.7					2.7
NNE															
NE															
ENE															
E		4.5													
ESE					3.6								3.6		
SE															
SSE				2.3									2.3		
S		6.8			3.3	4.4	2.3		2.5	2.3			3.3	2.6	2.4
SSW				8.2			4.5						8.2	4.5	
SW			4.5	4.5	2.7								4.1		
WSW															
W			4.1	4.5						2.3			4.3		2.3
WNW			3.6										3.6		
NW															
NNW															
TOTAL		5.7	4.1	4.8	3.2	4.4	2.7		2.5	2.4			3.8	2.9	2.4

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

YEAR: 1977

LEVEL: 100 meters

TIME (AM OR PM): a.m. #1 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N				20.0	16.7				100.0				11.8		20.0
NNE						20.0								8.3	
NE					16.7	20.0	14.3						5.9	16.7	
ENE															
E			16.7										5.9		
ESE			16.7		16.7								11.8		
SE			33.3	20.0	16.7		14.3						23.5	8.3	
SSE		25.0					14.3							8.3	
S			16.7		16.7	20.0	14.3						11.8	16.7	
SSW		50.0	16.7	20.0			14.3			25.0			11.8	8.3	20.0
SW						20.0	14.3							16.7	
WSW		25.0													
W						20.0								8.3	
WNW				20.0						50.0			5.9		40.0
NW										25.0					20.0
NNW				20.0	16.7		14.3						11.8	8.3	

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: 100 meters

YEAR: 1977

TIME (AM OR PM) : A.M. #1 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N				1.6	1.4				1.9				1.5		1.9
NNE						2.1								2.1	
NE					5.1	2.6	2.7						5.1	2.7	
ENE															
E			1.0										1.0		
ESE			3.9		2.9								3.4		
SE			6.2	3.8	0.4		1.2						4.1	1.2	
SSE		4.1					1.2							1.2	
S			5.1		5.1	1.6	6.7						5.1	4.2	
SSW		4.4	5.8	2.6			1.7			4.4			4.2	1.7	4.4
SW						1.5	7.0							4.3	
WSW		4.6													
W						1.6								1.6	
WNW				2.7						3.3			2.7		3.3
NW										2.9					2.9
NNW				3.4	0.9		0.8						2.2	0.8	
TOTAL		4.4	4.7	2.8	2.6	1.9	3.0		1.9	3.5			3.4	2.6	3.2

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

YEAR: 1977

LEVEL: 100 meters

TIME (AM OR PM): a.m. #2 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N						20.0	33.3		50.0					27.3	16.7
NNE				33.3									11.1		
NE					16.7	20.0							5.6	9.1	
ENE					16.7		16.7			25.0			5.6	9.1	16.7
E					16.7								5.6		
ESE			16.7		16.7								11.1		
SE															
SSE		50.0	16.7			20.0							5.6	9.1	
S		25.0	50.0	16.7	16.7								27.8		
SSW			16.7	16.7		20.0	50.0			25.0			11.1	36.4	16.7
SW		25.0													
WSW						20.0								9.1	
W										25.0				16.7	
WNW				16.7									5.6		
NW				16.7	16.7					25.0			11.1		16.7
NNW									50.0						16.7

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

YEAR: 1977

LEVEL: 100 m

TIME (AM OR PM) : A.M. #2 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N						0.7	0.7		1.2					0.7	1.2
NNE				8.2									8.2		
NE					4.1	0.6							7.1	0.6	
ENE					2.4		1.3			1.4			2.4	1.3	1.4
E					1.4								1.4		
ESE			1.0		2.2								1.6		
SE															
SSE		1.9	2.9			1.2							2.9	1.2	
S		2.7	11.6	4.7	4.3								8.7		
SSW			0.3	2.9		1.6	6.0			6.5			1.6	4.9	6.5
SW		2.5													
WSW						2.1								2.1	
W										3.3					3.3
WNW				1.7									1.7		
NW				1.8	1.4					2.8			1.6		2.8
NNW									1.6						1.6
TOTAL		2.3	6.5	4.6	2.6	1.2	3.5		1.4	3.5			4.6	2.4	2.8

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 100 meters

YEAR: 1977

TIME (AM OR PM): a.m. #3 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N					20.0				50.0				7.7		16.7
NNE			16.7										7.7		
NE															
ENE															
E		25.0			20.0		20.0			25.0			7.7	9.1	16.7
ESE							20.0							9.1	
SE			33.3			16.7							15.4	9.1	
SSE			16.7		20.0								15.4		
S		25.0	16.7			16.7	20.0						7.7	18.2	
SSW		25.0	16.7			16.7	20.0			25.0			7.7	18.2	16.7
SW		25.0		50.0		16.7	20.0						7.7	18.2	
WSW					20.0	16.7				25.0			7.7	9.1	16.7
W					20.0								7.7		
WNW										25.0					16.7
NW															
NNW				50.0		16.7			50.0				7.7	9.1	16.7

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: 100 m

YEAR: 1977

TIME (AM OR PM) : A.M. #3 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N					0.6				0.2				0.6		0.2
NNE			3.3										3.3		
NE															
ENE															
E		2.3			7.5		1.1			0.5			7.5	1.1	0.5
ESE							1.3							1.3	
SE			2.0			6.2							2.0	6.2	
SSE			5.3		2.1								3.7		
S		1.0	3.1			14.0	0.6						3.1	7.3	
SSW		2.7	2.4			8.5	3.7			1.9			2.4	6.1	1.9
SW		2.9		3.1		0.0	2.4						3.1	1.2	
WSW					0.7	0.5				3.8			0.7	0.5	3.8
W					0.8								0.8		
WNW										0.4					0.4
NW															
NNW				2.2		0.6			1.7				2.2	0.6	1.7
TOTAL		2.2	3.0	2.7	2.3	5.0	1.8		1.0	1.7			2.7	3.5	1.4

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 100 meters

YEAR: 1977

TIME (AM OR PM): a.m. #4 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N			33.3	66.7					50.0				27.3		16.7
NNE		25.0													
NE															
ENE					20.0								9.1		
E						25.0								11.1	
ESE						25.0	20.0		50.0					22.2	16.7
SE										25.0					16.7
SSE			33.3		20.0		40.0						18.2	22.2	
S		25.0			20.0								9.1		
SSW		25.0		33.3	20.0	25.0				25.0			18.2	11.1	16.7
SW			33.3		20.0		40.0						18.2	22.2	
WSW										25.0					16.7
W						25.0								11.1	
WNW		25.0													
NW															
NNW										25.0					16.7

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: 100m

YEAR: 1977

TIME (AM OR PM) : A.M. #4 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N			.9	4.2					1.9				3.4		1.9
NNE		0.5													
NE															
ENE					3.8								3.8		
E						1.1								1.1	
ESE						0.9	0.7		0.8					0.8	0.8
SE										0.3					0.3
SSE			3.8		0.5		1.9						2.2	1.9	
S		2.1			0.9								0.9		
SSW		3.9		2.8	1.4	6.2				1.7			2.1	6.2	1.7
SW			0.6		1.0		1.3						0.8	1.3	
WSW										5.9					5.9
W						1.5								1.5	
WNW		0.8													
NW															
NNW										1.0					1.0
TOTAL		1.8	2.1	3.7	1.5	2.4	1.4		1.4	2.2			2.3	1.9	1.9

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 100 meters

YEAR: 1977

TIME (AM OR PM): p.m. #1 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE															
ENE				20.0									7.7		
E										20.0					14.3
ESE															
SE									50.0						14.3
SSE			25.0		25.0	20.0	33.3						15.4	25.0	
S				40.0	25.0	40.0							23.1	25.0	
SSW		33.3	50.0	20.0	25.0	40.0	33.3		50.0	20.0			30.8	37.5	28.6
SW		66.7		20.0									7.7		
WSW							33.3			20.0				12.5	14.3
W			25.0		25.0					20.0			15.4		14.3
WNW															
NW															
NNW										20.0					14.3

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

YEAR: 1977

LEVEL: 100 meters

TIME (AM OR PM) : P.M. #1 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE															
ENE				7.2									7.2		
E										1.6					1.6
ESE															
SE									0.8						0.8
SSE			6.8		1.8	1.8	1.1						4.3	1.5	
S				2.5	4.8	4.3							3.3	4.3	
SSW		7.5	3.3	11.7	0.9	4.3	1.5		0.7	1.7			4.8	3.4	1.2
SW		1.0		10.3									10.3		
WSW							6.5			3.8				6.5	3.8
W			1.0		0.9					3.1			1.0		3.1
WNW															
NW															
NNW										2.1					2.1
TOTAL		3.2	3.6	6.8	2.1	3.8	3.0		0.8	2.5			4.4	2.5	2.0

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 100 meters

YEAR: 1977

TIME (AM OR PM): p.m. #2 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE			33.3										9.1		
NE															
ENE					33.3								9.1		
E				20.0									9.1		
ESE															
SE			33.3						50.0				9.1		20.0
SSE		33.3			33.3	20.0	25.0		50.0				9.1	22.2	20.0
S			33.3	20.0			25.0						18.2	11.1	
SSW		66.7		60.0		60.0							27.3	33.3	
SW					33.3	20.0	25.0			33.3			9.1	22.2	20.0
WSW															
W										33.3					20.0
WNW															
NW							25.0			33.3				11.1	20.0
NNW															

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls
LEVEL: 100 meters

YEAR: 1977
TIME (AM OR PM) : P.M. #2 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE			2.7										2.7		
NE															
ENE					6.1								6.1		
E				3.1									3.1		
ESE															
SE			2.3						0.4				2.3		0.4
SSE		4.2			3.8	7.3	5.9		3.4				3.8	6.6	3.4
S			6.8	2.2			0.5						4.5	0.5	
SSW		3.6		7.5		1.8							7.5	1.8	
SW					2.4	0.2	2.4			2.7			2.4	1.3	2.7
WSW															
W										2.6					2.6
WNW															
NW							1.2			1.8				1.2	1.8
NNW															
TOTAL		3.8	3.9	5.6	4.1	2.6	2.5		1.9	2.4			4.7	2.5	2.2

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 100 meters

YEAR: 1977

TIME (AM OR PM): p.m. #3 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE				20.0						25.0			8.3		16.7
NE					20.0								8.3		
ENE										25.0					16.7
E		50.0	50.0										8.3		
ESE					20.0				50.0				8.3		16.7
SE							20.0		50.0					10.0	16.7
SSE			50.0				40.0						8.3	20.0	
S				20.0		80.0							8.3	40.0	
SSW		50.0		60.0	40.0	20.0							41.7	10.0	
SW															
WSW							20.0							10.0	
W										25.0					16.7
WNW										25.0					16.7
NW					20.0								8.3		
NNW							20.0							10.0	

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: 100 meters

YEAR: 1977

TIME (AM OR PM) : P.M. #3 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE				0.4						0.5			0.4		0.5
NE					2.1								2.1		
ENE										1.0					1.0
E		3.6	1.6										1.6		
ESE					0.7				1.3				0.7		1.3
SE							0.8		0.7					0.8	0.7
SSE			0.9				3.9						0.9	3.9	
S				0.7		3.4							0.7	3.4	
SSW		3.9		7.1	6.2	9.6								9.6	
SW															
WSW							1.9							1.9	
W										4.6					4.6
WNW										0.5					0.5
NW					0.6										
NNW							1.3							1.3	
TOTAL		3.8	1.3	4.5	3.2	4.6	2.4		1.0	1.7			6.7	3.5	1.4

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 100 meters

YEAR: 1977

TIME (AM OR PM): p.m. #4 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N					20.0					25.0			7.7		16.7
NNE						20.0								10.0	
NE				20.0			20.0						7.7	10.0	
ENE									50.0						16.7
E					20.0		20.0						7.7	10.0	
ESE															
SE				20.0			20.0		50.0				7.7	10.0	
SSE		50.0	33.3		20.0								15.4		
S		50.0	33.3		20.0	20.0	20.0						15.4	20.0	
SSW			33.3	40.0		20.0							23.1	10.0	
SW					20.0								7.7		
WSW							20.0							10.0	
W															
WNW															
NW						40.0				75.0				20.0	50.0
NNW				20.0									7.7		

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: 100 meters

YEAR: 1977

TIME (AM OR PM) : P.M. #4 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N					8.3					0.8			8.3		0.8
NNE						1.8								1.8	
NE				4.6			0.4						4.6	0.4	
ENE									0.7						0.7
E					1.8		0.6						1.8	0.6	
ESE															
SE				5.3			0.6		0.2				5.3	0.6	0.2
SSE		1.9	2.3		0.7								1.5		
S		4.3	6.2		0.4	2.1	0.7						3.3	1.4	
SSW			1.0	5.1		2.3							3.7	2.3	
SW					1.8								1.8		
WSW							2.6							2.6	
W															
WNW															
NW						0.5				1.1				0.5	1.1
NNW				0.6									0.6		
TOTAL		3.1	3.2	4.1	2.6	1.4	1.0		0.5	1.0			3.3	1.2	0.8

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

YEAR: 1977

LEVEL: 200 meters

TIME (AM OR PM): a.m. #1 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N				20.0									5.9		
NNE				20.0									5.9		
NE					16.7		14.3		10.0				5.9	9.1	20.0
ENE															
E		25.0	16.7		16.7								11.8		
ESE			16.7										5.9		
SE							14.3							9.1	
SSE															
S			16.7	20.0	33.3	40.0	28.6						23.5	36.4	
SSW		50.0	33.3	20.0		20.0	14.3			25.0			17.6	18.2	20.0
SW							14.3							9.1	
WSW		25.0													
W				20.0						50.0			5.9		40.0
WNW															
NW					16.7	40.0	14.3			25.0			5.9	27.3	20.0
NNW			16.7		16.7								11.8		

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: 200 meters

YEAR: 1977

TIME (AM OR PM) : A.M. #1 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N				0.8									0.8		
NNE				3.2									3.2		
NE					4.4		3.3		1.6				4.4	3.3	1.6
ENE															
E		4.1	1.9		3.5								2.7		
ESE			0.9										0.9		
SE							1.4							1.4	
SSE															
S			10.3	4.1	2.7	1.0	3.7						5.0	2.4	
SSW		4.6	4.0	3.0		1.5	1.7			4.4			3.7	1.6	4.4
SW							8.2							8.2	
WSW		4.6													
W				2.7						3.7			2.7		3.7
WNW															
NW					1.4	0.5	1.0			2.9			1.4	0.7	2.9
NNW			0.7		1.6								1.2		
TOTAL		4.5	3.6	2.8	2.7	0.9	3.3		1.6	3.7			3.1	2.3	3.3

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

YEAR: 1977

LEVEL: 200 meters

TIME (AM OR PM): a.m. #2 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N							16.7							9.1	
NNE				50.0			16.7						16.7	9.1	
NE				16.7									5.6		
ENE					16.7								5.6		
E					16.7				50.0	25.0			5.6		33.3
ESE															
SE			16.7		16.7	20.0			50.0				11.1	9.1	16.7
SSE		50.0				20.0								9.1	
S		25.0	16.7		33.3	20.0	33.3						16.7	27.3	
SSW			33.3	33.3			33.3			25.0			22.2	9.1	16.7
SW		25.0	16.7										5.6		
WSW			16.7										5.6		
W						20.0				25.0				9.1	16.7
WNW										25.0					16.7
NW					16.7	20.0							5.6	9.1	
NNW															

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: 200 meters

YEAR: 1977

TIME (AM OR PM) : A.M. #2 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N							8.1							8.1	
NNE				4.8			0.4						4.8	0.4	
NE				0.9									0.9		
ENE					3.1								3.1		
E		2.2			3.2				0.6	0.9			3.2		0.8
ESE															
SE			1.2		1.2	0.9			1.3				1.2	0.9	1.3
SSE						4.0							4.0		
S		2.4	4.8		2.3	1.2	1.9						3.1	1.7	
SSW		5.2	4.5	4.1			7.5			5.7			4.3	7.5	5.7
SW			2.4										2.4		
WSW			0.3										0.3		
W						0.4				6.1				0.4	6.1
WNW										0.4					0.4
NW					1.3	1.1							1.3	1.1	
NNW															
TOTAL		3.1	3.0	3.9	2.2	1.5	4.6		1.0	3.3			3.0	3.2	2.5

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 200 meters

YEAR: 1977

TIME (AM OR PM): a.m. #3 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N				25.0						25.0			6.7		16.7
NNE			16.7		20.0								13.3		
NE															
ENE														9.1	
E		25.0													
ESE									50.0						16.7
SE						16.7				25.0				27.3	16.7
SSE			16.7		20.0	16.7	20.0						13.3	9.1	
S		25.0	50.0		40.0	50.0				25.0			33.3	36.4	16.7
SSW		25.0	16.7	25.0			60.0						13.3		
SW		25.0					20.0							9.1	
WSW															
W				25.0		16.7				25.0			6.7	9.1	16.7
WNW															
NW															
NNW				25.0	20.0				50.0				13.3		16.7

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: 200 meters

YEAR: 1977

TIME (AM OR PM) : A.M. #3 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N				2.6						0.7			2.6		0.7
NNE			0.7		3.0								1.9		
NE															
ENE															
E		4.6													
ESE									0.8						0.8
SE						0.4				1.4				0.4	1.4
SSE			0.7		1.0	0.7	1.3						0.9	1.0	
S		5.4	3.2		1.2	8.9				2.5			2.4	8.9	2.5
SSW		2.5	1.7	1.9			4.8						1.8	4.8	
SW		2.0					1.9							1.9	
WSW															
W				3.0		2.0				5.0			3.0	2.0	5.0
WNW															
NW															
NNW				2.1	1.0				1.3				1.6		1.3
TOTAL		3.6	2.1	2.4	1.5	5.0	3.5		1.1	2.4			2.0	4.3	2.0

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 200 meters

YEAR: 1977

TIME (AM OR PM): a.m. #4 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N				25.0	20.0								16.7		
NNE		25.0													
NE			33.3										8.3		
ENE										25.0					20.0
E															
ESE															
SE							20.0							11.1	
SSE						25.0								11.1	
S		25.0			20.0	25.0							8.3	11.1	
SSW		25.0		25.0	20.0								16.7		
SW					20.0		20.0		100.0	25.0			8.3	11.1	40.0
WSW					20.0	25.0				25.0			8.3	11.1	20.0
W				25.0									8.3		
WNW		25.0	66.7										16.7		
NW							40.0							22.2	
NNW				25.0		25.0	20.0			25.0			8.3	22.2	20.0

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: 200 meters

YEAR: 1977

TIME (AM OR PM) : a.m. #4 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N					1.5								1.5		
NNE		0.8													
NE			0.1	1.7									0.9		
ENE										1.2					1.2
E															
ESE															
SE							3.2							3.2	
SSE						1.4								1.4	
S					1.8	5.7							1.8	5.7	
SSW		3.5			2.4								2.4		
SW		2.6			0.5		3.1		0.4	1.4			0.5	3.1	0.9
WSW				1.4	0.8	1.5				4.0			1.1	1.5	4.0
W															
WNW			1.9										1.9		
NW							0.6							0.6	
NNW						0.9	0.4			1.2				0.7	1.2
TOTAL		2.4	1.3	1.6	1.4	2.4	1.6		0.4	2.0			1.4	1.9	1.6

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 200 meters

YEAR: 1977

TIME (AM OR PM): p.m. #1 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N		33.3				20.0								12.5	
NNE										20.0					14.3
NE															
ENE										20.0					14.3
E									50.0						14.3
ESE				20.0									10.0		
SE															
SSE							33.3							12.5	
S		33.3	100.0	20.0	50.0	40.0	33.3						40.0	37.5	
SSW		33.3		20.0	25.5	40.0							20.0	25.0	
SW				20.0	25.5								20.0		
WSW				20.0			33.3			20.0			10.0	12.5	14.3
W										20.0					14.3
WNW										20.0					14.3
NW									50.0						14.3
NNW															

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

YEAR: 1977

LEVEL: 200 meters

TIME (AM OR PM) : p.m. #1 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N		0.7				8.5								8.5	
NNE										1.0					1.0
NE															
ENE										1.6					1.6
E									0.9						0.9
ESE				3.9									3.9		
SE															
SSE							5.3							5.3	
S		4.7	4.3	3.7	4.3	3.9	1.9						4.2	3.2	
SSW		4.6		10.1	0.9	8.5							5.5	8.5	
SW				3.5	0.8								2.2		
WSW				2.7			5.7			4.3			2.7	5.7	4.3
W										4.1					4.1
WNW										1.4					1.4
NW									0.5						0.5
NNW															
TOTAL		3.3	4.3	4.8	2.6	6.7	4.3		0.7	2.5			3.9	5.8	2.0

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 200 meters

YEAR: 1977

TIME (AM OR PM): p.m. #2 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE															
ENE															
E															
ESE															
SE			33.3						50.0				8.3		20.0
SSE		33.3		40.0			25.0						16.7	11.1	
S			33.3	20.0		40.0	25.0		50.0				16.7	33.3	20.0
SSW		66.7		20.0	50.0	40.0	25.0						25.0	33.3	
SW					25.0		25.0						8.3	11.1	
WSW					25.0					66.7			8.3		50.0
W				20.0		20.0							8.3	11.1	
WNW			33.3										8.3		
NW										33.3					20.0
NNW															

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: 200 meters

YEAR: 1977

TIME (AM OR PM) : p.m. #2 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE															
ENE															
E															
ESE															
SE			30.5						1.2				30.5		1.2
SSE		4.6		3.1			2.8						3.1	2.8	
S			2.5	4.9		4.1	1.8		4.5				3.7	3.3	4.5
SSW		4.0		5.3	4.6	5.1	1.6						4.8	3.9	
SW					1.7		1.3						1.7	1.3	
WSW					2.7					3.9			2.7		3.9
W				0.4		1.6							0.4	1.6	
WNW			2.2										2.2		
NW										2.6					2.6
NNW															
TOTAL		4.2	11.7	3.4	3.4	4.0	1.9		2.9	3.3			5.5	3.1	3.2

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 200 meters

YEAR: 1977

TIME (AM OR PM): p.m. #3 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE															
ENE										25.0					16.7
E															
ESE															
SE			50.0	20.0	20.0		20.0						25.0	10.0	
SSE						20.0	20.0		50.0					20.0	16.7
S			50.0			20.0	20.0						8.3	20.0	
SSW				80.0	40.0	60.0			50.0				50.0	30.0	16.7
SW		50.0													
WSW					20.0					25.0			8.3		16.7
W					20.0		40.0						8.3	20.0	
WNW										25.0					16.7
NW															
NNW		50.0								25.0					16.7

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

YEAR: 1977

LEVEL: 200 meters

TIME (AM OR PM) : p.m. #3 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE															
ENE										0.2					0.2
E															
ESE															
SE			3.3	2.3	1.3		2.9						2.3	2.9	
SSE						4.5	3.9		0.6					4.2	0.6
S			4.0			9.5	0.6						4.0	5.1	
SSW				4.0	6.4	2.6			2.0				4.8	2.6	2.0
SW		2.0													
WSW					0.8					0.9			0.8		0.9
W					1.7		1.9						1.7	1.9	
WNW										2.7					2.7
NW															
NNW		0.6								1.0					1.0
TOTAL		1.3	3.7	3.7	3.3	4.4	2.2		1.3	1.2			3.5	3.3	1.2

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

YEAR: 1977

LEVEL: 200 meters

TIME (AM OR PM): p.m. #4 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N										25.0					16.7
NNE															
NE							20.0							10.0	
ENE						20.0								10.0	
E										25.0					16.7
ESE					20.0								7.7		
SE		50.0			20.0								7.7		
SSE			33.3	20.0			20.0		50.0				15.4	10.0	16.7
S				40.0	20.0		20.0						23.1	10.0	
SSW			33.3		20.0	80.0			50.0				15.4	40.0	16.7
SW		50.0													
WSW					20.0								7.7		
W							40.0			25.0				20.0	16.7
WNW										25.0					16.7
NW															
NNW			33.3	40.0									23.1		

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

YEAR: 1977

LEVEL: 200 meters

TIME (AM OR PM) : p.m. #4 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N										1.2					1.2
NNE															
NE							0.4							0.4	
ENE															
E										0.2					0.2
ESE					2.1	0.3							2.1	0.3	
SE		6.6			1.6								1.6		
SSE			3.5	6.2			0.6		0.5				4.9	0.6	0.5
S				3.2	1.8		0.7						2.7	0.7	
SSW			1.5		2.6	4.8			2.2				2.6	4.8	2.2
SW		1.9													
WSW					1.1								1.1		
W							1.7			2.5				1.7	2.5
WNW										0.8					0.8
NW															
NNW			1.4	0.9									1.0		
TOTAL		4.3	2.1	2.9	2.3	3.9	1.0		1.4	1.2			2.3	2.5	1.2

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 300 meters

YEAR: 1977

TIME (AM OR PM): a.m. #1 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE															
ENE					16.7								5.9		
E				20.0									5.9		
ESE					16.7	20.0	14.3						5.9	16.7	
SE		25.0	16.7	20.0									11.8		
SSE					16.7				100.0				5.9		20.0
S		25.0	33.3		33.3		28.6						23.5	16.7	
SSW		25.0	16.7	40.0		20.0	14.3			25.0			17.6	16.7	20.0
SW						40.0	14.3							25.0	
WSW		25.0	33.3										11.8		
W				20.0		20.0				50.0			5.9	8.3	40.0
WNW					16.7		14.3						5.9	8.3	
NW							14.3							8.3	
NNW										25.0					20.0

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: 300 m

YEAR: 1977

TIME (AM OR PM) : a.m. #1 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE															
ENE					2.4								2.4		
E				5.2									5.2		
ESE					5.5	1.4	4.0						5.5	2.7	
SE		2.2	1.1	1.0									1.1		
SSE					4.1				3.0				4.1		3.0
S		6.0	14.9		1.3		3.9						8.1	3.9	
SSW		6.9	3.5	3.8		2.4	1.5			3.3			3.0	2.0	3.3
SW						2.4	7.8							4.2	
WSW		4.6	2.1										2.1		
W				2.4		0.7				3.5			2.4	0.7	3.5
WNW					1.5		0.7						1.5	0.7	
NW							0.7							0.7	
NNW										0.8					0.8
TOTAL		4.9	5.4	3.2	2.7	1.9	3.2		3.0	2.8			4.0	2.7	2.8

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 300 meters

YEAR: 1977

TIME (AM OR PM): a.m. #2 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N				25.0									6.3		
NNE									50.0						16.7
NE															
ENE					16.7					25.0			6.3		16.7
E															
ESE		25.0			16.7				50.0				6.3		16.7
SE															
SSE			16.7		16.7								12.5		
S		50.0	16.7				16.7						6.3	9.1	
SSW		25.0	16.7	75.0		40.0	33.3						25.0	36.4	
SW			50.0		16.7		16.7			25.0			25.0	9.1	16.7
WSW					16.7	20.0	16.7						6.3	18.2	
W										50.0					33.3
WNW					16.7	20.0							6.3	9.1	
NW						20.0								9.1	
NNW							16.7							9.1	

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

YEAR: 1977

LEVEL: 300 m

TIME (AM OR PM) : a.m. #2 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N				1.2									1.2		
NNE									0.5						0.5
NE															
ENE					2.3					0.3			2.3		0.3
E															
ESE		3.0			7.3				0.7				7.3		0.7
SE															
SSE			2.3		3.5								2.9		
S		4.1	5.0				0.7						5.0	0.7	
SSW		6.6	2.3	3.8		3.6	5.3						3.4	4.5	
SW			4.2		2.1		3.7			4.6			3.2	3.7	4.6
WSW					1.0	2.1	1.9						1.0	2.0	
W										4.9					4.9
WNW					1.3	0.6							1.3	0.6	
NW						0.6								0.6	
NNW							1.8							1.8	
TOTAL		4.5	3.5	3.2	2.9	2.1	3.1		0.6	3.7			3.3	2.7	2.7

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

YEAR: 1977

LEVEL: 300 meters

TIME (AM OR PM): a.m. #3 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE									50.0						16.7
NE				25.0									7.1		
ENE							20.0							9.1	
E		33.3													
ESE															
SE			20.0		40.0		40.0		50.0				21.4	18.2	16.7
SSE						50.0								27.3	
S		33.3				16.7	20.0							18.2	
SSW		33.3	40.0	50.0	20.0					25.0			35.7		16.7
SW			20.0		20.0	16.7	20.0			25.0			14.3	18.2	16.7
WSW															
W			20.0							25.0			7.1		16.7
WNW					20.0								7.1		
NW						16.7				25.0				9.1	16.7
NNW				25.0									7.1		

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: 300 m

YEAR: 1977

TIME (AM OR PM) : a.m. #3 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE									0.7						0.7
NE				0.8									0.8		
ENE							1.4							1.4	
E		4.6													
ESE															
SE			7.0		1.5		2.0		1.1				3.3	2.0	1.1
SSE						3.5								3.5	
S		4.6				10.2	12.6							11.4	
SSW		3.2	0.5	2.0	2.6					4.0			1.5		4.0
SW			1.1		1.0	4.0	4.9			0.1			1.1	4.5	0.1
WSW															
W			2.1							4.0			2.1		4.0
WNW					1.5								1.5		
NW						1.3				1.1				1.3	1.1
NNW				6.7									6.7		
TOTAL		4.1	2.7	2.9	1.6	4.3	4.6		0.9	2.3			2.2	4.5	1.8

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 300 meters

YEAR: 1977

TIME (AM OR PM): a.m. #4 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N						25.0								11.1	
NNE				100.0									11.1		
NE										25.0					16.7
ENE															
E					20.0								11.1		
ESE		33.3					20.0							11.1	
SE															
SSE									50.0						16.7
S			33.3		20.0	25.0			50.0				22.2	11.1	16.7
SSW		67.7			40.0					25.0			22.2		16.7
SW							20.0							11.1	
WSW					20.0		20.0						11.1	11.1	
W			66.7			25.0	20.0			50.0			22.2	22.2	33.3
WNW															
NW															
NNW						25.0	20.0							22.2	

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: 300 m

YEAR: 1977

TIME (AM OR PM) : a.m. #4 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N						2.9								2.9	
NNE		0.8		1.1									1.1		
NE										0.8					0.8
ENE															
E					7.0								7.0		
ESE							5.5							5.5	
SE															
SSE									1.3						1.3
S			1.1		2.9	3.2			0.7				2.0	3.2	0.7
SSW		3.5			3.1					1.2			3.1		1.2
SW		2.6					1.6							1.6	
WSW					1.5		1.9						1.5	1.9	
W			3.9			1.2	0.3			3.4			3.9	0.8	3.4
WNW															
NW															
NNW						1.1	2.4							1.8	
TOTAL		2.4	2.3	1.1	3.5	2.1	2.3		1.0	1.8			2.8	2.3	1.8

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 300 meters

YEAR: 1977

TIME (AM OR PM): p.m. #1 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE										20.0					14.3
NE															
ENE		33.3								20.0					14.3
E															
ESE															
SE				40.0					50.0				15.4		14.3
SSE			25.0			20.0	33.3			20.0			7.7	25.0	14.3
S			50.0	20.0	25.0	40.0	33.3						30.8	37.5	
SSW		66.7	25.0	20.0	25.0	40.0							23.1	25.0	
SW				20.0	25.0								15.4		
WSW					25.0		33.3			20.0			7.7	12.5	14.3
W										20.0					14.3
WNW															
NW															
NNW									50.0						14.3

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

YEAR: 1977

LEVEL: 300 m

TIME (AM OR PM) : p.m. #1 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE										2.0					2.0
NE															
ENE		1.1								0.6					0.6
E															
ESE															
SE				2.1					0.8				2.1		0.8
SSE			5.4			2.7	2.7			1.1			5.4	2.7	1.1
S			5.8	3.2	3.0	7.1	2.0						4.4	5.4	
SSW		5.6	6.5	5.9	6.3	8.4							6.2	8.4	
SW				8.5	2.7								5.6		
WSW					1.9		6.0			5.5			1.9	6.0	5.5
W										4.4					4.4
WNW															
NW															
NNW									0.4						0.4
TOTAL		4.1	5.9	4.4	3.5	6.7	3.6		0.6	2.7			4.5	5.6	2.1

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 300 meters

YEAR: 1977

TIME (AM OR PM): P.M. #2 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N										33.3					20.0
NNE															
NE															
ENE															
E															
ESE															
SE		33.3		20.0			25.0						10.0	11.1	
SSE				20.0			25.0						10.0	11.1	
S			33.3	40.0		40.0							30.0	22.2	
SSW		66.7	66.7	20.0	50.0		25.0		50.0				40.0	11.1	20.0
SW						20.0								11.1	
WSW					50.0	40.0	25.0		50.0				10.0	33.3	20.0
W										66.7					40.0
WNW															
NW															
NNW															

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

YEAR: 1977

LEVEL: 300 m

TIME (AM OR PM) : p.m. #2 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N										0.6					0.6
NNE															
NE															
ENE															
E															
ESE															
SE		2.7		4.2			1.0						4.2	1.0	
SSE				2.9			2.4						2.9	2.4	
S			3.1	4.5		6.5							4.0	6.5	
SSW		4.1	5.1	4.0	8.9		3.0		0.8				6.3	3.0	0.8
SW						3.0								3.0	
WSW					3.5	2.0	4.4		0.9				3.5	2.8	0.9
W										4.2					4.2
WNW															
NW															
NNW															
TOTAL		3.6	4.4	4.0	6.2	4.0	2.7		0.9	3.0			4.8	3.4	2.1

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 300 meters

YEAR: 1977

TIME (AM OR PM): P.M. #3 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE										25.0					16.7
NE		50.0													
ENE															
E															
ESE					20.0								8.3		
SE							20.0							10.0	
SSE				20.0			20.0						8.3	10.0	
S					20.0	20.0			50.0				8.3	10.0	16.7
SSW		50.0	50.0	20.0	20.0	60.0			50.0				25.0	30.0	16.7
SW			50.0	60.0		20.0	40.0						33.3	30.0	
WSW					40.0					25.0			16.7		16.7
W							20.0							10.0	
WNW										25.0					16.7
NW										25.0					16.7
NNW															

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: 300 m

YEAR: 1977

TIME (AM OR PM) : p.m. #3 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE										1.1					1.1
NE		0.6													
ENE															
E															
ESE					3.7								3.7		
SE							5.0							5.0	
SSE				1.3			3.5						1.3	3.5	
S					3.2	6.1			1.4				3.2	6.1	1.4
SSW		1.1	4.0	1.0	5.2	7.0			4.1				3.4	7.0	4.1
SW			6.1	3.4		1.6	1.6						4.1	1.6	
WSW					1.7					2.8			1.7		2.8
W							2.9							2.9	
WNW										4.9					4.9
NW										2.4					2.4
NNW															
TOTAL		0.9	5.1	2.5	2.1	5.7	2.9		2.8	2.8			3.2	4.3	2.8

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 300 meters

YEAR: 1977

TIME (AM OR PM): P.M. #4 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE										25.0					16.7
NE															
ENE															
E															
ESE		100.0		20.0									7.7		
SE			33.3		20.2	20.0							15.4	10.0	
SSE									50.0						16.7
S			33.3		20.0	20.0	20.0		50.0				15.4	20.0	16.7
SSW				60.0		20.0	40.0						23.1	30.0	
SW			33.3		20.0	20.0							15.4	10.0	
WSW					20.0		20.0						7.7	10.0	
W					20.0	20.0	20.0						7.7	20.0	
WNW										25.0					16.7
NW										25.0					16.7
NNW				20.0						25.0			7.7		16.7

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: 300 m

YEAR: 1977

TIME (AM OR PM) : p.m #4 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE										3.7					3.7
NE															
ENE															
E															
ESE		5.2		1.6									1.6		
SE			8.8		3.9	0.4							6.4	0.4	
SSE									2.5						2.5
S			4.2		1.0	1.1	1.8		4.2				2.6	1.5	4.2
SSW				8.9		4.7	2.1						8.9	2.9	
SW			1.7		4.2	4.5							3.0	4.5	
WSW					2.9		2.6						2.9	2.6	
W					4.7	5.0	1.7						4.7	3.4	
WNW										5.8					5.8
NW										1.5					1.5
NNW				0.6						1.0			0.6		1.0
TOTAL		5.2	4.9	5.8	3.3	3.1	2.1		3.4	3.0			4.6	2.6	3.1

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 500 meters

YEAR: 1977

TIME (AM OR PM): A.M. #1 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N							14.3							8.3	
NNE															
NE															
ENE															
E															
ESE		25.0			33.3								11.8		
SE				40.0		14.3				25.0			11.8	8.3	20.0
SSE			16.7		16.7								11.8		
S			33.3	20.0	33.3		14.3						29.4	8.3	
SSW		25.0			16.7	80.0	28.6			25.0			5.9	50.0	20.0
SW		25.0	33.3	40.0			14.3						23.5	8.3	
WSW		25.0	16.7										5.9		
W										25.0					20.0
WNW							14.3		100.0	25.0				8.3	40.0
NW															
NNW						20.0								8.3	

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: 500 m

YEAR: 1977

TIME (AM OR PM) : a.m. #1 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N							0.7							0.7	
NNE															
NE															
ENE															
E															
ESE		5.7			4.7								4.7		
SE				7.7			7.6			1.9			7.7	7.6	1.9
SSE			4.5		4.4								4.5		
S			5.9	3.0	5.7		2.4						5.2	2.4	
SSW		5.4			2.2	6.9	5.3			5.0			2.2	6.4	5.0
SW		4.5	5.3	3.8			10.5						4.6	10.5	
WSW		4.6	6.1										6.1		
W										5.5					5.5
WNW							1.2		0.6	7.8				1.2	4.2
NW															
NNW						1.0								1.0	
TOTAL		5.1	5.5	5.2	4.6	5.7	4.7		0.6	5.1			4.9	5.2	4.2

Values in meters per second

AVERAGE WIND SPEED

SITE: Columbia Falls

YEAR: 1977

LEVEL: 500 m

TIME (AM OR PM) : a.m. #2 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N						1.0	1.5			2.1				1.3	2.1
NNE															
NE															
ENE															
E															
ESE					6.1								6.1		
SE		2.6		1.6	5.3				0.8				3.5		0.8
SSE					4.1	1.1							4.1	1.1	
S			4.3	3.0	4.2	7.6	8.3			6.9			4.0	8.0	6.9
SSW		5.6	4.7	8.0	2.9	5.6	4.7		0.7				5.8	5.3	0.7
SW		6.0	3.4				8.3						3.4	8.3	
WSW					1.9		2.6			7.1			1.9	2.6	7.1
W															
WNW										5.7					5.7
NW															
NNW															
TOTAL		5.0	4.4	5.7	4.1	4.2	5.6		0.8	5.5			4.7	5.0	3.9

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 500 meters

YEAR: 1977

TIME (AM OR PM): A.M. #2 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N						20.0	16.7			25.0				18.2	16.7
NNE															
NE															
ENE															
E															
ESE					16.7								5.9		
SE				20.0	16.7				50.0				11.8		16.7
SSE					16.7	20.0							5.9	9.1	
S			33.3	20.0	16.7	20.0	16.7			25.0			23.5	18.2	16.7
SSW		50.0	50.0	60.0	16.7	40.0	16.7		50.0				41.2	27.3	16.7
SW		50.0	16.7				33.3						5.9	18.2	
WSW					16.7		16.7			25.0			5.9	9.1	16.7
W															
WNW										25.0					16.7
NW															
NNW															

Values in percent

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 500 meters

YEAR: 1977

TIME (AM OR PM): A.M. #3 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N				25.0			25.0						9.1	10.0	
NNE															
NE															
ENE															
E		50.0													
ESE					33.3								9.1		
SE							25.0							10.0	
SSE				50.0					50.0	33.3			18.2		40.0
S			25.0			33.3				33.3			9.1	20.0	20.0
SSW		50.0	25.0	25.0	33.3		25.0						27.3	10.0	
SW					33.3	50.0							9.1	30.0	
WSW			25.0										9.1		
W															
WNW									50.0						20.0
NW			25.0			16.7	25.0			33.3			9.1	20.0	20.0
NNW															

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

YEAR: 1977

LEVEL: 500 m

TIME (AM OR PM) : a.m. #3 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N				6.2			1.4						6.2	1.4	
NNE															
NE															
ENE															
E		3.0													
ESE					1.1								1.1		
SE							2.6							2.6	
SSE				2.4					1.7	0.4			2.4		1.1
S			7.1			3.0				6.5			7.1	3.0	6.5
SSW		5.1	4.5	2.8	7.0		11.4						4.8	11.4	
SW					1.9	3.6							1.9	3.6	
WSW			8.5										8.5		
W															
WNW									7.2						7.2
NW			16.7			0.5	3.1			4.9			16.7	1.8	4.9
NNW															
TOTAL		4.1	9.2	3.5	3.3	2.9	4.6		4.5	3.9			5.5	3.6	4.2

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 500 meters

YEAR: 1977

TIME (AM OR PM): P.M. #1 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE															
ENE										20.0					14.3
E															
ESE		33.3													
SE				20.0			33.3						7.7	14.3	
SSE															
S			50.0	20.0		25.0				20.0			23.1	14.3	14.3
SSW		33.3	25.0		50.0	50.0			50.0				23.1	28.6	14.3
SW		33.3	25.0	60.0	25.0	25.0	33.3						38.5	28.6	
WSW					25.0		33.3		50.0				7.7	14.3	14.3
W										40.0					28.6
WNW															
NW															
NNW										20.0					14.3

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: 500 m

YEAR: 1977

TIME (AM OR PM) : p.m. #1 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE															
ENE										1.0					1.0
E															
ESE		2.6													
SE				5.3			8.6						5.3	8.6	
SSE															
S			11.2	4.6		4.3				8.1			9.0	4.3	8.1
SSW		3.7	4.3		5.6	6.7			9.1				5.1	6.7	9.1
SW		7.6	6.4	5.1	1.5	2.8	4.5						4.6	3.7	
WSW					2.7		9.0		1.5				2.7	9.0	1.5
W										5.3					5.3
WNW															
NW															
NNW										2.8					2.8
TOTAL		4.6	8.3	5.0	3.9	5.1	7.4		5.3	4.3			5.7	6.1	4.7

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 500 meters

YEAR: 1977

TIME (AM OR PM): P.M. #2 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N										33.3					25.0
NNE															
NE							25.0							11.1	
ENE															
E															
ESE															
SE															
SSE															
S			33.3	40.0		40.0	25.0		50.0				25.0	33.3	25.0
SSW		50.0	33.3	40.0	25.0	60.0			50.0				33.3	33.3	25.0
SW		50.0		20.0	25.0								16.7		
WSW					25.0		50.0						8.3	22.2	
W			33.3							66.7			8.3		25.0
WNW															
NW															
NNW					25.0								8.3		

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

YEAR: 1977

LEVEL: 500 m

TIME (AM OR PM) : p.m. #2 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N										0.5					0.5
NNE															
NE							1.3							1.3	
ENE															
E															
ESE															
SE															
SSE															
S			19.4	6.5		6.1	4.6		1.3				10.8	5.6	1.3
SSW		5.1	9.4	5.1	1.1	6.2			4.5				5.2	6.2	4.5
SW		5.6		0.0	2.7								1.4		
WSW					3.3		3.0						3.3	3.0	
W			3.4							6.9			3.4		6.9
WNW															
NW															
NNW					4.6								4.6		
TOTAL		5.4	10.7	4.6	2.9	6.2	3.0		2.9	4.8			5.6	4.7	4.0

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 500 meters

YEAR: 1977

TIME (AM OR PM): P.M. #3 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE															
ENE															
E															
ESE							25.0							11.1	
SE		100.0		20.0									8.3		
SSE															
S			50.0		40.0	20.0							25.0	11.1	
SSW				20.0	40.0		50.0		100.0				25.0	22.2	20.0
SW				60.0		60.0							25.0	33.3	
WSW			50.0		20.0		25.0						16.7	11.1	
W										25.0					20.0
WNW										25.0					20.0
NW															
NNW						20.0				50.0				11.1	40.0

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

YEAR: 1977

LEVEL: 500 m

TIME (AM OR PM) : p.m. #3 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE															
ENE															
E															
ESE							5.0							5.0	
SE		1.3		1.7									1.7		
SSE															
S			14.2		3.0	0.7							6.7	0.7	
SSW				1.5	5.0		3.1		4.3				3.8	3.1	4.3
SW				7.2		4.6							7.2	4.6	
WSW			4.8		1.1		3.8						3.0	3.8	
W										8.1					8.1
WNW										5.3					5.3
NW															
NNW						1.5				5.3				1.5	5.3
TOTAL		1.3	9.5	5.0	3.4	3.2	3.0		4.3	6.0			5.1	3.4	5.7

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 750 meters

YEAR: 1977

TIME (AM OR PM): A.M. #1 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE															
ENE															
E										33.3					25.0
ESE															
SE				20.0	20.0		14.3						12.5	8.3	
SSE		33.3		20.0									6.3		
S			33.3	20.0	40.0								31.3		
SSW		33.3	16.7	20.0		40.0	42.9		100.0	33.3			12.5	41.7	50.0
SW		33.3	33.3		20.0	60.0	42.9						12.5	50.0	
WSW			16.7	20.0	20.0								18.8		
W															
WNW										33.3					25.0
NW															
NNW															

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: 750 m

YEAR: 1977

TIME (AM OR PM) : a.m. #1 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE															
ENE															
E										0.4					0.4
ESE															
SE				9.0	6.6		11.6						7.8	11.6	
SSE		5.7		1.7									1.7		
S			7.0	1.4	7.9								6.2		
SSW		5.2	13.3	5.0		4.9	6.0		7.0	12.2			9.2	5.6	9.6
SW		4.4	6.0		3.0	7.4	7.3						5.0	7.4	
WSW			7.1	5.1	2.1								4.8		
W															
WNW										11.4					11.4
NW															
NNW															
TOTAL		5.1	7.7	4.4	5.5	6.4	7.4		7.0	8.0			6.0	7.0	7.8

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 750 meters

YEAR: 1977

TIME (AM OR PM): A.M. #2 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N										33.3					20.0
NNE							16.7							10.0	
NE															
ENE				25.0									9.1		
E				25.0									9.1		
ESE					20.0								9.1		
SE		100.0			20.0								9.1		
SSE				25.0									9.1		
S									50.0						20.0
SSW			50.0		40.0	50.0	33.3						27.3	40.0	
SW			50.0		20.0	25.0	16.7		50.0	33.3			18.2	20.0	40.0
WSW				25.0									9.1		
W							33.3							20.0	
WNW															
NW										33.3					20.0
NNW						25.0								10.0	

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: 750 m

YEAR: 1977

TIME (AM OR PM) : a.m. #2 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N										1.5					1.5
NNE							1.3							1.3	
NE															
ENE				12.4									12.4		
E				4.7									4.7		
ESE					7.8								7.8		
SE		2.4			6.3								6.3		
SSE				1.5									1.5		
S									10.2						10.2
SSW			8.3		12.4	7.4	14.0						10.3	10.7	
SW			12.4		2.1	4.3	9.7		2.4	9.8			9.0	7.0	6.0
WSW				3.2									3.2		
W							12.6							12.6	
WNW															
NW										11.0					11.0
NNW						8.5								8.5	
TOTAL		2.4	10.4	5.5	8.2	6.9	10.7		6.3	7.4			8.0	9.2	6.9

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 750 meters

YEAR: 1977

TIME (AM OR PM): A.M. #3 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE															
ENE															
E		50.0													
ESE															
SE															
SSE				33.3			66.7						11.1	25.0	
S			66.7			20.0				33.3			22.2	12.5	25.0
SSW		50.0	33.3	33.3	66.7	20.0				33.3			44.4	12.5	25.0
SW						60.0			100.0					37.5	25.0
WSW					33.3								11.1		
W							33.3							12.5	
WNW				33.3						33.3			11.1		25.0
NW															
NNW															

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: 750 m

YEAR: 1977

TIME (AM OR PM) : a.m. #3 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE															
ENE															
E		1.6													
ESE															
SE															
SSE				2.5			1.9						2.5	1.9	
S			5.8			12.5				3.8			5.8	12.5	3.8
SSW		8.2	10.4	10.1	8.4	6.8				9.3			9.3	6.8	9.3
SW						6.7			3.3					6.7	3.3
WSW					1.0								1.0		
W							3.1							3.1	
WNW				2.2						17.1			2.2		17.1
NW															
NNW															
TOTAL		4.9	7.3	4.9	5.9	7.9	2.3		3.3	10.1			6.1	5.8	8.4

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 750 meters

YEAR: 1977

TIME (AM OR PM): P.M. #1 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE			25.0							20.0			8.3		14.3
ENE															
E															
ESE															
SE		50.0		25.0			33.3						8.3	14.3	
SSE				25.0									8.3		
S						25.0			50.0					14.3	14.3
SSW			25.0	25.0	50.0	25.0	33.3		50.0	20.0			33.3	28.6	28.6
SW			25.0	25.0		25.0							16.7	14.3	
WSW		50.0			25.0		33.3			20.0			8.3	14.3	14.3
W					25.0								8.3		
WNW						25.0				20.0				14.3	14.3
NW			25.0										8.3		
NNW										20.0					14.3

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

YEAR: 1977

LEVEL: 750 m

TIME (AM OR PM) : p.m. #1 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE			3.1							7.2			3.1		7.2
ENE															
E															
ESE															
SE				4.5			6.7						4.5	6.7	
SSE		5.7		1.2									1.2		
S						8.9			3.8					8.9	3.8
SSW		5.2	6.4	10.7	7.4	5.3	3.2		8.2	3.7			8.0	4.3	6.0
SW		4.4	5.1	4.9		6.0							5.0	6.0	
WSW					4.2		13.1			8.1			4.2	13.1	8.1
W					2.8								2.8		
WNW						2.3				5.3				2.3	5.3
NW			1.7										1.7		
NNW										11.6					11.6
TOTAL		5.1	4.1	5.3	5.5	5.6	7.7		6.0	7.2			5.0	6.5	6.9

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 750 meters

YEAR: 1977

TIME (AM OR PM): P.M. #2 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE															
ENE															
E															
ESE															
SE		100.0		25.0									9.1		
SSE										50.0					33.3
S			33.3			25.0	25.0		100.0				9.1	25.0	33.3
SSW					25.0	50.0	25.0						9.1	37.5	
SW					25.0		25.0						9.1	12.5	
WSW			33.3	25.0	25.0	25.0	25.0						27.3	25.0	
W			33.3	25.0	25.0								27.3		
WNW										50.0					33.3
NW															
NNW				25.0									9.1		

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: 750 m

YEAR: 1977

TIME (AM OR PM) : p.m. #2 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE															
ENE															
E															
ESE															
SE				4.2									4.2		
SSE										2.0					2.0
S			14.2			5.9	4.2		6.9				14.2	5.1	6.9
SSW					5.3	7.9	3.4						5.3	6.4	
SW					6.2		4.6						6.2	4.6	
WSW			4.5	5.8	4.4	5.5	9.9						4.9	7.7	
W		6.2	7.1	1.9	2.9								4.0		
WNW										8.0					8.0
NW															
NNW				3.5									3.5		
TOTAL		6.2	8.6	3.9	4.7	6.8	5.5		6.9	5.0			5.5	6.2	5.6

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 750 meters

YEAR: 1977

TIME (AM OR PM): P.M. #3 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE															
ENE															
E															
ESE					25.0								10.0		
SE					25.0								10.0		
SSE							25.0							12.5	
S				25.0			25.0						10.0	12.5	
SSW			50.0	25.0	25.0	75.0			100.0	33.3			30.0	37.5	50.0
SW				25.0		25.0	25.0						10.0	25.0	
WSW				25.0	25.0		25.0						20.0	12.5	
W															
WNW			50.0							33.3			10.0		25.5
NW															
NNW										33.3					25.5

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: 750 m

YEAR: 1977

TIME (AM OR PM) : p.m. #3 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE															
ENE															
E															
ESE					4.3								4.3		
SE					1.7								1.7		
SSE							4.7							4.7	
S				1.3			4.1						1.3	4.1	
SSW			5.3	3.8	3.5	9.1			4.8	1.5			4.2	9.1	3.2
SW				11.2		13.5	2.3						11.2	7.9	
WSW				3.3	10.9		5.8						7.1	5.8	
W															
WNW			6.9							9.0			6.9		9.0
NW															
NNW										11.8					11.8
TOTAL			6.1	4.9	5.1	10.2	4.2		4.8	7.4			5.2	7.2	6.8

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 1000 meters

YEAR: 1977

TIME (AM OR PM): A.M. #1 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE							16.7							10.0	
NE															
ENE															
E				20.0									7.1		
ESE															
SE															
SSE		100.0			20.0								7.1		
S						25.0	16.7							20.0	
SSW			50.0			25.0	16.7						14.3	20.0	
SW			25.0	40.0	40.0		33.3		100.0	33.3			35.7	20.0	50.0
WSW				40.0	40.0	50.0	16.7			33.3			28.6	30.0	25.0
W															
WNW			25.0										7.1		
NW										33.3				25.0	
NNW															

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: 1000 m

YEAR: 1977

TIME (AM OR PM) : a.m. #1 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE							11.1							11.1	
NE															
ENE															
E				2.0									2.0		
ESE															
SE															
SSE		4.4			5.2								5.2		
S						7.5	5.7							6.6	
SSW			8.6			4.9	5.0						8.6	5.0	
SW			11.2	5.5	6.7		7.1		7.6	11.2			7.1	7.1	9.4
WSW				5.3	2.9	10.8	8.7			0.6			4.1	10.1	0.6
W															
WNW			1.9										1.9		
NW										17.6					17.6
NNW															
TOTAL		4.4	7.6	4.7	4.9	8.5	7.5		7.6	9.8			5.6	7.9	9.3

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 1000 meters

YEAR: 1977

TIME (AM OR PM): A.M. #2 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE															
ENE															
E				33.3									10.0		
ESE															
SE					25.0		16.7						10.0	10.0	
SSE		100.0								50.0					33.3
S						25.0								10.0	
SSW			66.7		25.0								30.0		
SW			33.3	33.3	25.0	25.0	33.3		100.0	50.0			30.0	30.0	66.7
WSW					25.0	25.0	33.3						10.0	30.0	
W				33.3			16.7						10.0	10.0	
WNW															
NW															
NNW						25.0								10.0	

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

YEAR: 1977

LEVEL: 1000 m

TIME (AM OR PM) : a.m. #2 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE															
ENE															
E				19.1									19.1		
ESE															
SE					5.1		8.6						5.1	8.6	
SSE		4.5								0.6					0.6
S						4.4								4.4	
SSW			11.0		7.5								9.8		
SW			13.9	3.5	10.1	15.4	19.2		4.3	10.7			7.9	17.9	7.5
WSW					1.3	7.3	3.3						1.3	4.6	
W				8.2			22.0						8.2	22.0	
WNW															
NW															
NNW						8.5								8.5	
TOTAL		4.5	12.0	10.3	6.0	8.9	12.6		4.3	5.7			9.1	11.1	5.2

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

LEVEL: 1000 meters

YEAR: 1977

TIME (AM OR PM): P.M. #1 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE			33.3							20.0			11.1		16.7
ENE															
E															
ESE		100.0		33.3			50.0						11.1	16.7	
SE															
SSE															
S															
SSW						50.0			100.0	20.0				33.3	33.3
SW			33.3	66.7	33.3	25.0	50.0						44.4	33.3	
WSW			33.3										11.1		
W					66.7	25.0				20.0			22.2	16.7	16.7
WNW										20.0					16.7
NW															
NNW										20.0					16.7

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

LEVEL: 1000 m

YEAR: 1977

TIME (AM OR PM) : p.m. #1 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE			3.1							7.2			3.1		7.2
ENE															
E															
ESE				4.5			6.7						4.5	6.7	
SE		0.9													
SSE															
S															
SSW						9.0			8.2	5.7				9.0	7.0
SW			5.8	7.1	7.5	9.2	3.9						6.9	6.6	
WSW			2.7										2.7		
W					5.1	4.9				13.1			5.1	4.9	13.1
WNW										5.5					5.5
NW															
NNW										24.0					24.0
TOTAL		0.9	3.9	6.2	5.9	8.0	5.3		8.2	11.1			5.3	7.1	10.6

Values in meters per second

WIND FREQUENCY TABLE

SITE: Columbia Falls

YEAR: 1977

LEVEL: 1000 meters

TIME (AM OR PM): P.M. #2 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE															
ENE															
E															
ESE															
SE				25.0									11.1		
SSE							33.3							14.3	
S			50.0										11.1		
SSW						50.0	33.3		100.0	50.0				42.9	66.7
SW				50.0	33.3	25.0	33.3						33.3	28.6	
WSW				25.0	33.3	25.0							22.2	14.3	
W			50.0		33.3								22.2		
WNW		100.0								50.0					33.3
NW															
NNW															

Values in percent

AVERAGE WIND SPEED

SITE: Columbia Falls

YEAR: 1977

LEVEL: 1000 m

TIME (AM OR PM) : p.m. #2 balloon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SPR	SUM	AUT
N															
NNE															
NE															
ENE															
E															
ESE															
SE				4.6									4.6		
SSE							8.0							8.0	
S			12.8										12.8		
SSW						11.9	8.6		7.8	5.3			10.8	6.6	
SW				6.9	6.2	4.2	2.1						6.7	3.2	
WSW				8.6	13.8	9.2							11.2	9.2	
W			13.6		3.9								8.8		
WNW		13.4								12.4				12.4	
NW															
NNW															
TOTAL		13.4	13.2	6.8	8.0	9.3	6.2		7.8	8.9			8.6	8.0	8.5

Values in meters per second

APPENDIX B

Sampling Site Descriptions

Primary Site

The primary site for this study was chosen in the north-central end of the valley. The site eventually settled upon was one-half mile south of the Glacier National Airport. An attempt was made at first to locate the sampling equipment at the airport, as this is also the location of a National Weather Service station. Equipment was originally installed on September 23, 1976. However, problems such as lack of storage space and poor access to equipment caused the move of the equipment on January 24, 1977, to a location adjacent to the airport. This site also provided the ability to use historical data collected by the National Weather Service. A small camper trailer had to be purchased to house instrument recorders and to provide storage of supplies. Power was already at the site but had to be reconnected. The site worked well as the land that was leased was vacant and no houses were closer than one-half mile. The people of the area were also used to activity because of the airport. The airplane traffic did not cause any problems as no tall towers were constructed and no tethered balloons were used. Figure 4 shows two views of the primary site. The primary site was located far enough from the valley to have little effect from drainage or upslope-downslope flows. The primary site was selected

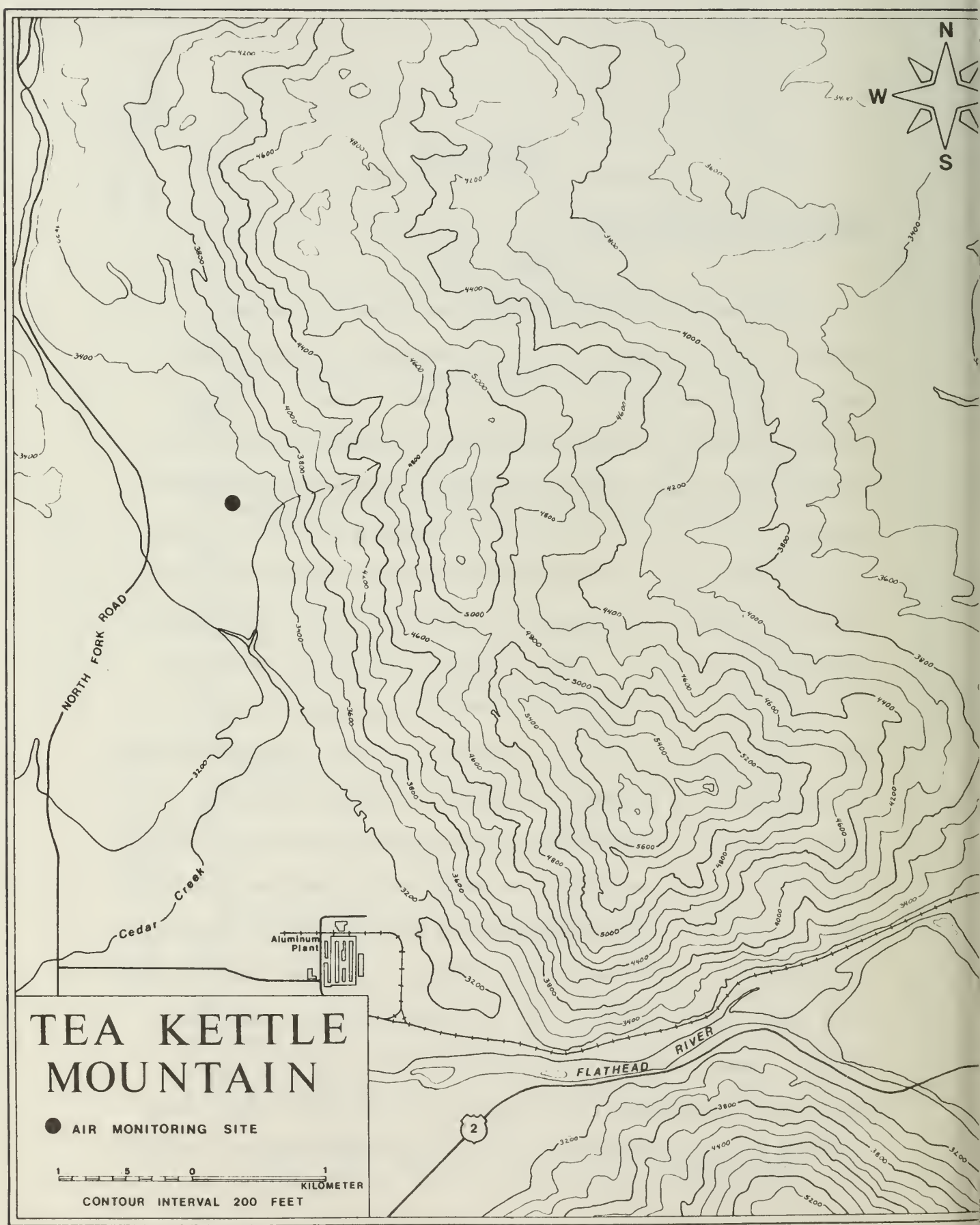
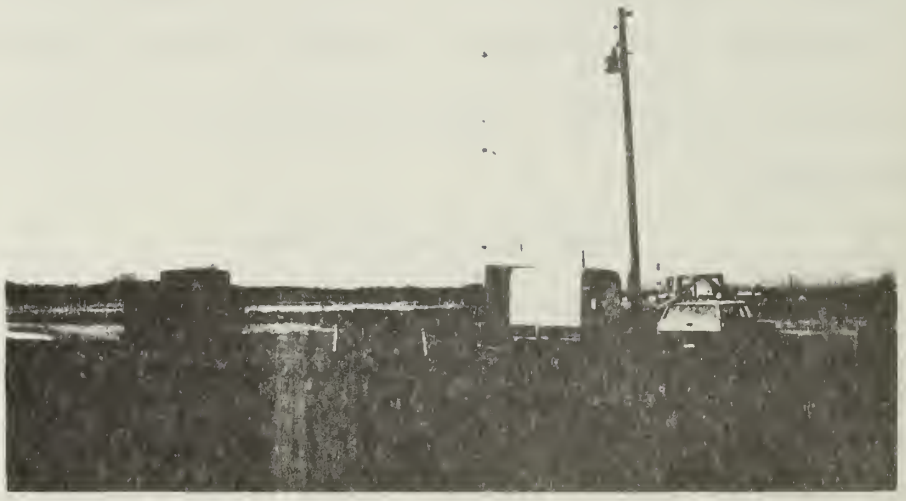

N
W
S
NORTH FORK ROAD
Cedar Creek
Aluminum Plant
FLATHEAD RIVER
2
TEA KETTLE MOUNTAIN
AIR MONITORING SITE
1 5 0 1
KILOMETER
CONTOUR INTERVAL 200 FEET

FIGURE 6

and equipment installed in January, 1977. Equipment used at the site included an acoustic radar; surface wind, temperature and solar insolation; dual theodolite pilot balloons; mini-temperature sondes; and a nephelometer. Data was also obtained from the National Weather Service.

Teakettle Mountain Site

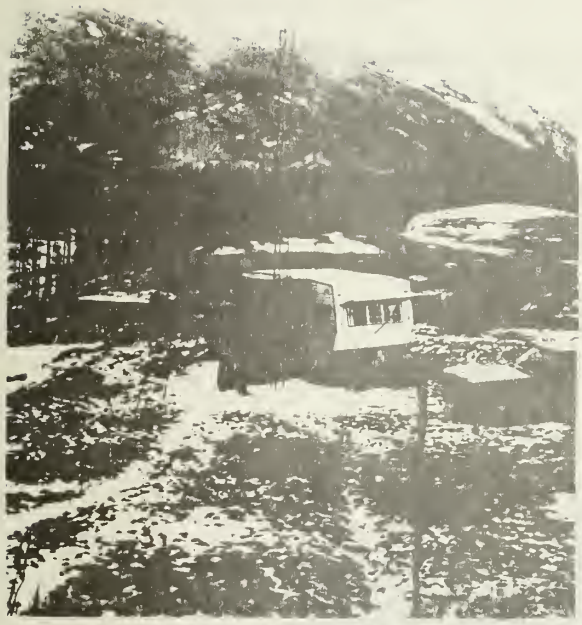
The Teakettle Mountain site was installed to obtain a description of the flow around the Teakettle Mountain directly north of the Anaconda plant. Initially an attempt was made to install the equipment at the plant itself. However, access to the location provided would have caused many problems, and a decision was made to install the equipment at an existing air quality site less than one mile NW of the plant (Figure 6). This site already had a trailer, a 10m tower and power. The equipment was then installed on September, 1976. However, late in 1976, the Anaconda Company informed the Department that the site could no longer be used and all equipment except the air quality sampler had to be removed. The site then obtained was located on land owned by the city of Columbia Falls. The site was located 2.2 miles north-northwest of the plant and only ¼ mile west of Teakettle Mountain (Figures 5 and 6). This site was actually a better site as it was located at any equal distance from the Teakettle Mountain, as the plant itself (mountain was actually a long ridge). Since the objective of the site was to study the mountain airflow, this location was fortunate. The site also had a greater view for tracking of pilot balloons. The Teakettle Mountain site then included dual theodolite pilot balloons, surface wind, temperature and solar insolation.



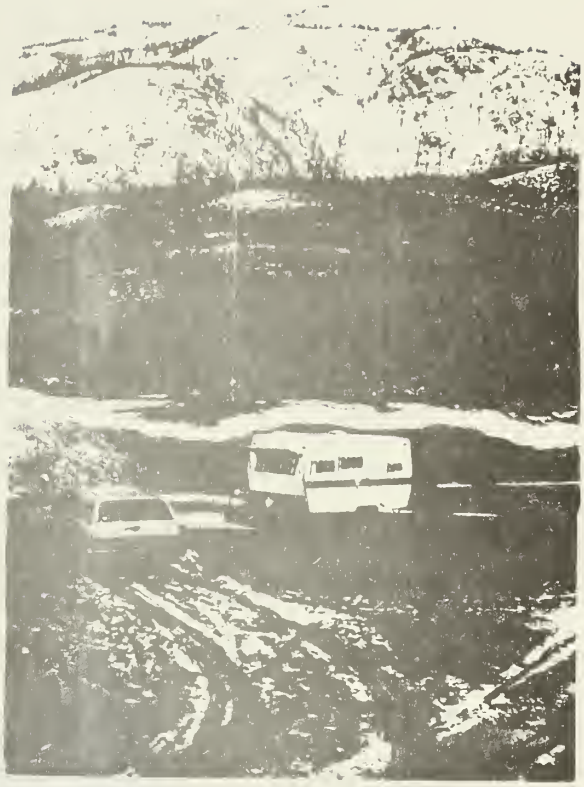
View to North

FIGURE 4 - Primary Site

View to Southeast



View to South
(Note - plant plume)



View to East

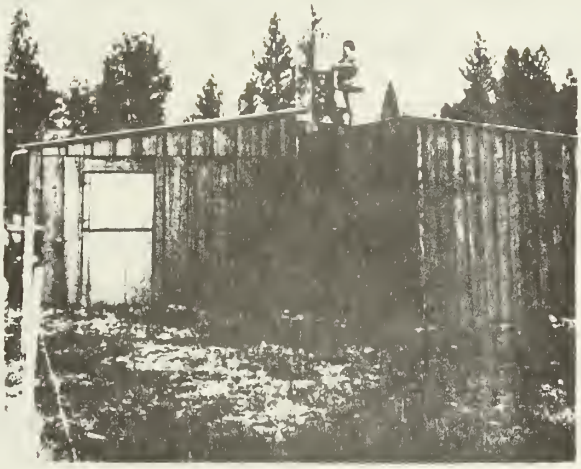
Figure 5 - Teakettle Mountain Site

View to Northwest

Badrock Canyon Site

The third site utilized was located in the line of flows moving in and out of the Badrock Canyon. Since no location was available directly in the canyon, a site was picked that would be directly influenced by the canyon winds and be able to describe that area. The site picked was located on private property, some 3.6 miles south-southwest of the Anaconda plant. Equipment located at this site included only surface wind (10m tower).

Data was also requested from the Anaconda Company as they recorded wind speed and direction, temperature, pressure and precipitation at the plant. However, the request was denied. Other data sources used included the surface data from the National Weather Service at Glacier International Airport and upper air studies from data taken at Spokane, Washington; Boise, Idaho; and Great Falls, Montana.



View to North

Figure 7 - Badrock Canyon Site

Meteorological Instrumentation

Surface Winds

All the surface wind information, except for that data obtained from the National Weather Service, was obtained from a 20 foot tower. The sensors and recorders used were made by the Climatronics, Corp.* The recorders were a Rustrak variety. The system provided a convenient package in that the wind, temperature and solar insolation all were recorded on one chart recorder located at the tower base. The temperature sensor was a naturally asperated and shielded probe with an accuracy of $\pm$1.0 deg F and a range of -40 to +120 F. The solar sensor was pyranometer with an accuracy of $\pm$5 percent of 0.6 Langleys. The response was from 0.35 to 1.15 um with a peak at 0.85 um. The pyranometer was calibrated again an Eppley pyranometer at the factory before shipping to Montana. The wind speed sensor was a photo-chopper sensor that had two wind ranges, 0-50 and 0-100 mph. The 0-50 range was used in all cases. The resulting accuracy was 0.5 mph. The threshold was 0.75 mph with a time constant of 8 feet and a damping ratio of 0.4-0.6. The wind direction sensor used was a standard wind vane with a 540 degree span.

Several problems occurred with the sensors used. At two sites no power was installed at first, therefore dictating the use of 6-volt batteries. The system used two batteries at one time. The problem was that, even though the recorders were installed in a wooden enclosure, the batteries would only last from one to two weeks

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*Any mention of an equipment supplier should not be construed as an endorsement.

depending on the severity of the weather. Due to the unreliability of this power, existing power supplies were tapped and 115 volt power was used from then on.

A second problem that occurred was that the chart drives when in the form of rolling up the used chart and could not keep accurate time. Conversion was made to the "tearoff" mode for convenience to the operator which also solved the time problem. Charts were still time checked periodically throughout the study. The recorders on several occasions failed and had to be sent to Helena for repair. This caused some data loss but was not significant. Experience dictated a supply of certain components were kept on hand at Helena for quick repair of the recorders. The recorders were noted to be easy to work on by the technicians.

Surface Temperature

Surface temperature was obtained from the Climatronics system and the NWS observations. Similar problems, as occurred with the surface wind, occurred with the temperature because of the use of a package system. The accuracy of the sensor and description is given in "Surface Winds" above.

Solar Insolation

Solar insolation was obtained from the Climatronics system also. A description of the sensor is given in "Surface Winds" above. Periodic cleaning of the glass hemisphere was required. The sensors were located in the most advantageous position to minimize the chance of shadows from power lines or towers. Again similar problems occurred with the solar insolation as in the wind system because of the package system used.

Nephelometer

A Meteorology Research Inc. integrating nephelometer was used at the primary site. The output was recorded on a Leeds and Northrup single pen recorder. The nephelometer consisted of an optical assembly, signal conditioning electronics, and sampling and purge air pumps. The air samples were drawn continuously through a chamber where it was illuminated by a pulsed flash lamp. The scattered light was detected by a photomultiplier tube looking at the illuminated air sample. The signal produced by the photomultiplier is averaged and compared with a reference voltage from another phototube looking at the flash lamp. The instrument used also consisted of an intake air heater to prevent measurement of airborne particles with moisture condensed on them. The area where measurements were being taken often has fairly high relative humidities.

The nephelometer was calibrated often during the study using filtered air and Freon-12. The instrument appeared to hold a calibration well and very minor adjustment was required.

Acoustic Radar

An Aerovironment Inc. Model 300A acoustic radar was installed at the primary site. The antenna dish was heated and enclosed in an Aerovironment acoustic enclosure located some 20 feet from the trailer. The radar recorder, located in the trailer, had the timing mask indicator for recording the end of each hour. The transceiver used had the higher power option and 120-volt power requirement. The antenna dish had a built-in heater to prevent accumulation of ice and snow. This heater caused some problems when first used, as the thermistor would not trip, allowing power to be supplied to the

heater. This required the thermistor section to be returned to the company for repair. During the absence of the thermistor, electrical heat tape was wrapped around the bottom of the antenna dish. This replacement worked well and caused no problem.

The transmitter receiver, cable and heater power cord were enclosed in plastic pipe and buried about six inches underground. The use of metal conduit was not necessary as the radar cable was shielded itself.

The antenna dish was enclosed in a shelter provided by Aerovironment. This enclosure consisted of five interlocking plywood sheets lined with thin lead and convoluted polyurethane foam. The plywood and lead attenuate sound impinging on the enclosure walls, thus reducing the noise detected by the antenna sidelobes. The foam prevents internal reverberations and thereby limits internal echoes of the transmitted pulse and reduces the noise level from sound diffracted into the enclosure opening. This enclosure did not provide adequate insulation due to highway traffic and periodic train traffic some one-half mile away. To add insulation, hay bales were stacked completely around the enclosure up to one foot from the top. This added insulation provided sufficient protection to provide adequate reception of the signal.

The radar had two heights available for recording of the echo. These were 500 and 1000 meters. The 1000 meter range was used throughout the study.

Radar charts after being shipped to Helena were cut in 24-hour segments and sprayed with a clear lacquer to prevent smearing of the record when handling.

The radar charts were interpreted by meteorologists and reduced to computer format for summarizing. The charts were analyzed for relative stability in two-hour blocks, inversion height, thickness and type, in six-hour blocks, significant occurring events, inversion formation and lifting time, and the rate at which the inversion lifted.

Pilot Balloons

The upper level wind measurements were made through the use of pilot balloons launched from the primary site and the Teakettle Mountain site. Weather Measure theodolites and balloons were used on the program. The balloons used were 30 gram red balloons. The balloons released from the primary site were calibrated using one or two standard calibrated weights. The Teakettle Mountain balloons were calibrated to four standard weights. These weights and approximate lift rates are shown in Table 17. Even though dual theodolite observations were made on most occasions, standard weighted balloons were used in case one observer lost the balloon, the second observer's data could be recorded as a single theodolite observation. Also, in the case of the Teakettle Mountain site, four weights were used to better define the airflow. All readings of azimuth, elevation and other pertinent data were recorded on standard forms.

Observations were taken every 30 seconds on the balloon runs. Timers were constructed to provide a signal to the two observers to obtain simultaneous readings. Several timing systems were attempted before one final system was settled upon. The first system tried to use walkie-talkies in conjunction with one buzzer to provide a signal. This system did not provide a loud enough signal to the

TABLE 17

LIFT RATES FOR VARIOUS BALLOONS*

Weight No.	Weight (g)	Lift Rate (m/sec)+
1	72.0	2.75
2	33.9	1.78
3	15.0	1.28
4	5.7	0.78

*Rates apply to Weather Measure (Japanese) 30g balloons only.

+Reference p. 280 Final Report Part I, Atmospheric Water Resources Management Program, Montana State University, A. B. Super, et. al. December, 1972.

furthest removed observer. Interference from local noises and poor reception on the radios were the major problems. A second system was employed of a parent timer unit plugged into 120 volt power. From this unit two buzzers were connected out to the observation sites. Since one site was located some 200 yards from the parent unit, this caused some problems of unwinding and winding up of the cord. The final system settled on was a large horn attached to the parent unit which could easily be heard out to a distance of 200 yards.

The data was summarized using a method for dual measurements given by Thyer (1961). A fairly complex computer program was written to analyze and plot single theodolite pilot balloons, dual theodolite pilot balloons, series of dual theodolite pilot balloons and pibals run with minisondes. The program could interpolate between missing readings or if a dual observation run was started and one observer would lose the balloon, the analysis would switch to a single theodolite analysis with assumed lift rates.

Temperature Sondes

Mini-temperature sondes were released near the end of the project on a random basis. Releases were made from the primary site for approximately three months. The mini-sondes and receiver used were manufactured by Contel Corp. Problems occurred at first with the system as reception was good only for the first few minutes. The system was converted to the crystal controlled system at the company's recommendation. This conversion allowed much longer runs to be made (greater than one hour on occasion). Most runs were

cut to 20-25 minutes as this was the information most important to the study (lower 2000 meters). The pilot balloon lift rates were still calibrated using the addition of the mini-sonde to allow a standard lift rate.

The initial plans were to run the temperature sondes over a one-year period to provide calibration to the acoustic radar for measurement of inversion heights and mixing heights. However, even with the converted receiver, the temperature sonde system never worked satisfactorily. Various instrument problems and problems in operation of the receiver prevented the obtaining of useful data from this system. This section of the study was the most disappointing of all the areas. Since the start of the Columbia Falls study, other meteorological studies have been initiated around the state using mini-temperature sondes. However, other systems were employed and much more productive results were obtained. At the time of the writing of this report, a second meteorological study is starting in the Flathead Valley. It is hoped that better data on inversion heights and mixing heights will be obtained.

Operation Schedule and Man Power

The equipment used in the study was operated mostly by Jim Peterson, Air Analyst with the Air Quality Bureau. Since this work was done in addition to his regular work with the Bureau, Peterson could not devote his entire attention to the project. Given this work restriction, it is not surprising that some data losses occurred due to instrument failure or chart problems. Charts and instruments were checked as frequently as practicable. Assistance in the operation of pilot balloons and temperature sondes was obtained from two part-time workers, Paul Atkins and Roy Anders. On many occasions these people did construction or electrical work that was not required of them. Without their assistance on this project, much higher costs would have occurred and possibly delays in the study itself. This work was really appreciated but this extra work required should be planned for in future projects in any budgets. Charts from the project were read by a local contractor and recorded on computer forms. All data processing was performed on the Montana Department of Highways IBM 370 computer located in Helena. All analysis programs were written by the Air Quality Bureau.

The operation schedule was fairly loose because of the man-power restriction. Single theodolite pilot balloons were tracked in the morning and afternoon from the primary site on as many days as possible. On four or five days a month, a day was designated as a "series" day. On these days a pilot balloon was tracked from the primary site at about 0900 MST. Then starting at about 1000 MST four different weighted pilot balloons were tracked at the Teakettle

Mountain site. At 1300 MST four additional balloons were again tracked at the Teakettle site. Then at about 1500 MST one pilot balloon was tracked from the primary site. Based on the acoustic radar record, it was then determined as to what relative stability the balloon was released under.